ZOOM
TECHNOLOGIES

CCNA
Cisco Certified Network Associate

Lab Manual

CCNA

(Cisco Certified Network Associate)

Certification Mapped Course

Routing and Switching

Lab Manual

Introduction

We are pleased to release the revised and updated lab manual for CCNA version 3. This lab manual is designed as a practical supplement to the concepts taught in the CCNA - version 3 mapped Routing and Switching course at Zoom Technologies India Pvt. Ltd.

We have lab exercises on all the topics covered in the CCNA-version 3 course. All the new topics have been given extensive coverage. This comprehensive manual will sufficiently prepare a student for the CCNA exam and more importantly equip him/ her with the right skills to design, install, maintain and troubleshoot WAN networks in the real world. We have also added a challenge lab at the end, to give the student a feel of the practical aspects of the CCNA exam.

Each of the exercises is divided into the five sections:

1. Objective
2. Topology
3. Tasks
4. Configuration
5. Verification

The lab manual leads the students from the basic initial configuration of a router to advanced topics like inter-vlan routing, OSPF- multi area configuration, EIGRP fine tuning, BGP configuration, password recovery, etc.

We hope that this lab manual would be helpful to the students in solidifying their foundation in WAN networking. Any feedback or suggestions to improve this would be gratefully accepted.

Table of Contents

EXERCISE 1: BINARY TO DECIMAL CONVERSION

128	64	32	16	8	4	2	1	ANSWER IN DECIMAL	SCRATCH AREA
1	0	0	1	0	0	1	0		
1	1	0	0	0	0	0	0		
1	0	1	0	1	0	0	0		
0	1	0	0	0	0	0	0		
0	0	0	0	1	0	1	0		

EXERCISE 2: DECIMAL TO BINARY CONVERSION

DECIMAL	ANSWER IN BINARY								SCRATCH AREA
	128	64	32	16	8	4	2	1	
167									
63									
17									
24									
254									

EXERCISE 3: ADDRESS CLASS IDENTIFICATION

ADDRESS	CLASS
126.10.1.1	
128.10.1.1	
162.78.1.10	
39.255.255.255	
220.1.1.10	

EXERCISE 4: NETWORK AND HOST IDENTIFICATION BASED ON CLASS OF ADDRESS

CIRCLE THE NETWORK PORTION OF BELOW ADDRESSES	CIRCLE THE HOST PORTION OF BELOW ADDRESSES
132.12.1.1	161.43.5.6
128.10.1.1	13.1.100.254
176.13.10.10	202.153.32.121
162.78.1.10	100.140.2.230
200.1.1.1	171.24.100.10

EXERCISE 5: DEFAULT SUBNET MASK

ADDRESS	CLASS
126.10.1.1	
128.10.1.1	
162.78.1.10	
52.255.255.255	
220.1.1.10	

EXERCISE 6: NETWORK ADDRESS

USING THE IP ADDRESS AND SUBNET MASK SHOWN, WRITE THE NETWORK ADDRESS

IP ADDRESS AND SUBNET MASK	NETWORK ADDRESS
121.12.1.1 255.0.0.0	
175.13.10.10 255.255.0.0	
200.1.10.1 255.255.255.0	
119.0.255.20 255.0.0.0	
191.168.1.10 255.255.0.0	

EXERCISE 7: BROADCAST ADDRESS

USING THE IP ADDRESS AND SUBNET MASK SHOWN, WRITE THE BROADCAST ADDRESS

IP ADDRESS AND SUBNET MASK	BROADCAST ADDRESS
161.43.5.6 255.255.0.0	
13.1.100.254 255.0.0.0	
202.153.32.121 255.255.255.0	
100.140.2.230 255.0.0.0	
171.24.100.10 255.255.0.0	

EXERCISE 8: CISCO SLASH NOTATION

SLASH NOTATION	SUBNET MASK
/29	
/22	
/12	
/25	
/18	

EXERCISE 9: BINARY TO HEXA DECIMAL CONVERSION

																ANSWER IN HEXADECIMAL
												1	1	1	1	
								1	1	0	1	1	0	1	1	
				1	0	1	1	1	0	1	1	1	0	1	0	
1	0	1	1	1	0	1	0	1	0	1	1	1	0	1	0	
1	1	0	0	1	0	1	0	1	1	1	1	1	1	1	0	
1	1	1	1	1	0	1	0	1	1	0	0	1	1	1	0	
1	1	0	0	0	0	0	1	0	1	0	1	1	1	0	0	

EXERCISE 10: HEXADECIMAL TO BINARY CONVERSION

HEXADECIMAL																
E																
9																
2F																
4FD																
01E8																
2001																
FE80																

EXERCISE 11: OMISSION OF ZERO'S

IPv6 ADDRESS	IPv6 ADDRESS AFTER OMISSION OF ZERO'S
2001:2222:0000:0000:0000:0000:0000:0001	
20DB:C0A8:0101:0000:0000:0000:0000:0042	
2000:0000:0000:4DAD:0023:0046:00BB:0101	
FF02:0000:0000:0000:0000:0000:0000:0001	
0000:0000:0000:0000:0000:0000:0000:0001	

EXERCISE 12: REPLACING SUCCESSIVE FIELDS OF ZERO'S WITH "::"

IPv6 ADDRESS	IPv6 ADDRESS AFTER REPLACING SUCCESSIVE FIELDS OF ZERO'S WITH "::"
2002:1111:04CF:0000:0000:0000:0000:002F	
3FFF:0000:0000:0000:0000:005D: 0000:09CE	
2001:0000:0000: FACE: B00C:0000:0000:0069	
20DB:0000:0000:6666:0000:0000:0000:5228	
2001:1111:0000:0000:0000:0000:0000:0001	

EXERCISE 13: CUSTOM SUBNET MASK (SUBNETTING)

PROBLEM : 1	
Number of needed subnets	14
Network Address	200.10.10.0
Address class	
Default subnet mask	
Custom subnet mask	
Total number of subnets	
Total number of host addresses	
Number of usable addresses	
Number of bits borrowed from the host portion	

PROBLEM : 2	
Number of needed usable hosts	60
Network Address	171.10.0.0
Address class	
Default subnet mask	
Custom subnet mask	
Total number of subnets	
Total number of host addresses	
Number of usable addresses	
Number of bits borrowed from the host portion	

PROBLEM : 3	
Network Address	138.25.0.0/26
Address class	
Default subnet mask	
Custom subnet mask	
Total number of subnets	
Total number of host addresses	
Number of usable addresses	
Number of bits borrowed from the host portion	

PROBLEM : 4	
Number of needed subnets	2000
Network Address	111.0.0.0
Address class	
Default subnet mask	
Custom subnet mask	
Total number of subnets	
Total number of host addresses	
Number of usable addresses	
Number of bits borrowed from the host portion	

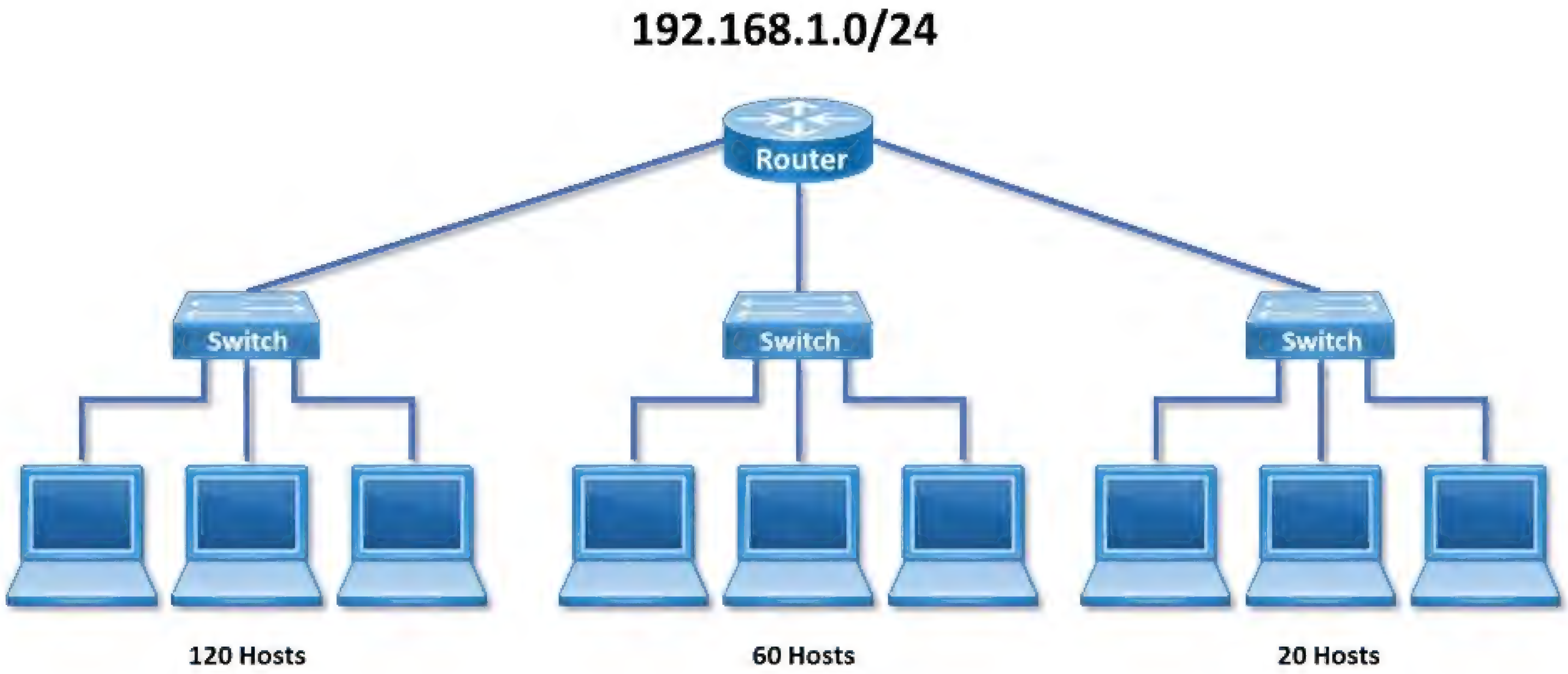
PROBLEM : 5	
Number of needed usable hosts	1000
Network Address	165.34.0.0
Address class	
Default subnet mask	
Custom subnet mask	
Total number of subnets	
Total number of host addresses	
Number of usable addresses	
Number of bits borrowed from the host portion	

PROBLEM : 6	
Network Address	192.100.1.0/29
Address class	
Default subnet mask	
Custom subnet mask	
Total number of subnets	
Total number of host addresses	
Number of usable addresses	
Number of bits borrowed from the host portion	

EXERCISE 14: VARIABLE LENGTH SUBNET MASK (VLSM)

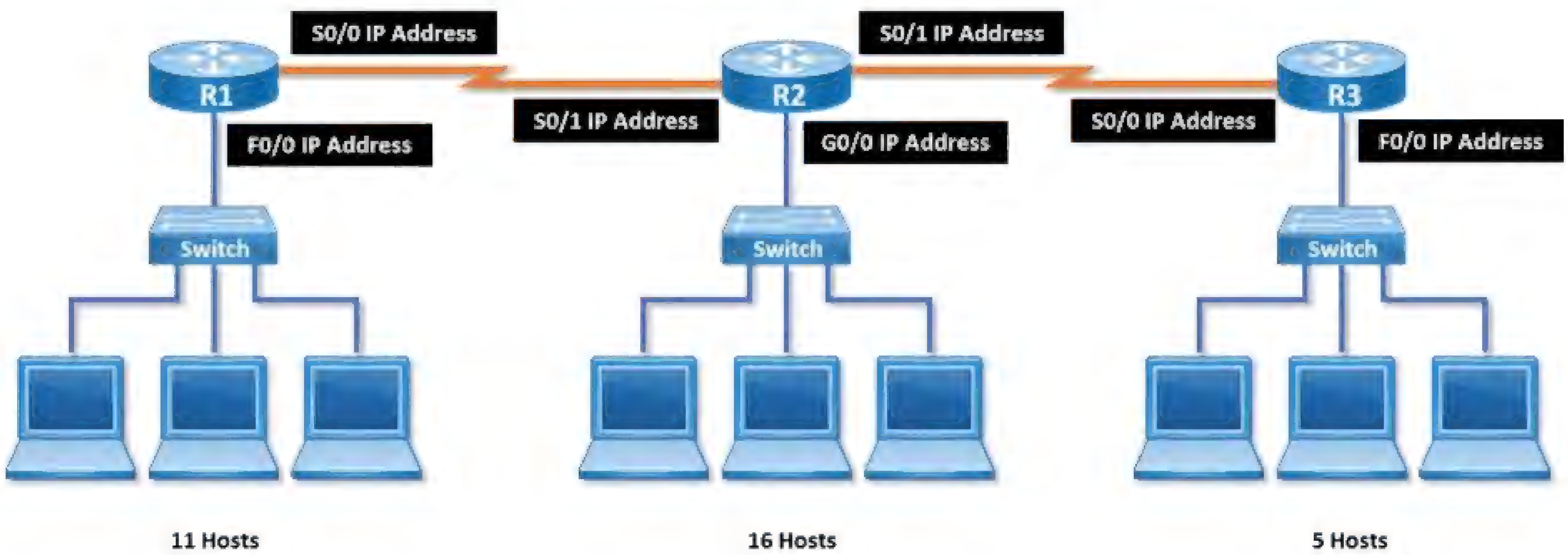
PROBLEM: 1

The administrator gave the networking team 192.168.1.0/24 to use for addressing the entire network. After subnetting the address, the team is ready to assign the addresses



PROBLEM: 2

The administrator gave the networking team 192.168.164.0/24 to use for addressing the entire network. After subnetting the address, the team is ready to assign the addresses. The administrator plans to configure ip subnet-zero and use RIP v2 as the routing protocol. As a member of the networking team, you must address the network and at the same time conserve unused addresses for future growth.



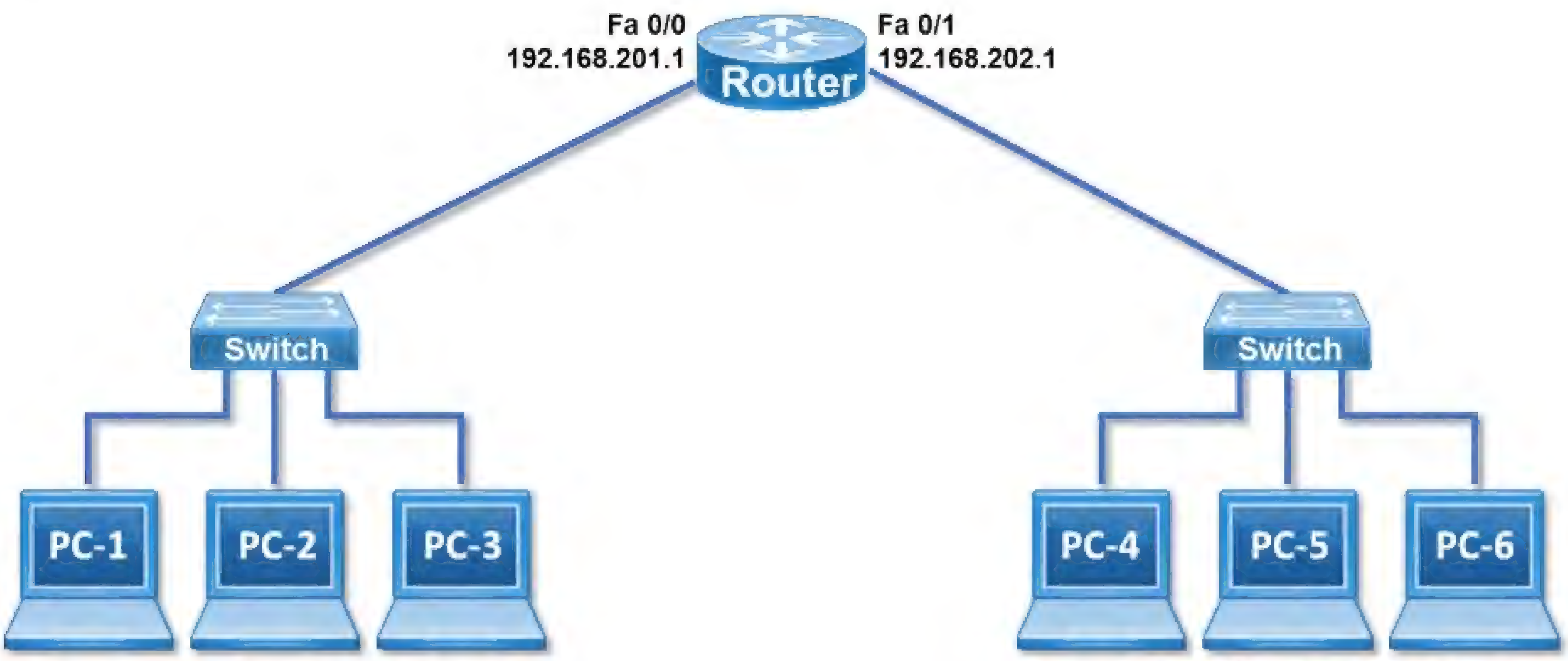
LAB 1: UNDERSTANDING IPv4 NETWORK COMMUNICATION

OBJECTIVE:

To verify communication between same network and different network computers after assigning IPv4 Address and Default Gateway.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Computer	IP Address / Mask
PC-1	192.168.201.10/24
PC-2	192.168.201.20/24
PC-3	192.168.201.30/24

Computer	IP Address / Mask
PC-4	192.168.202.10/24
PC-5	192.168.202.20/24
PC-6	192.168.202.30/24

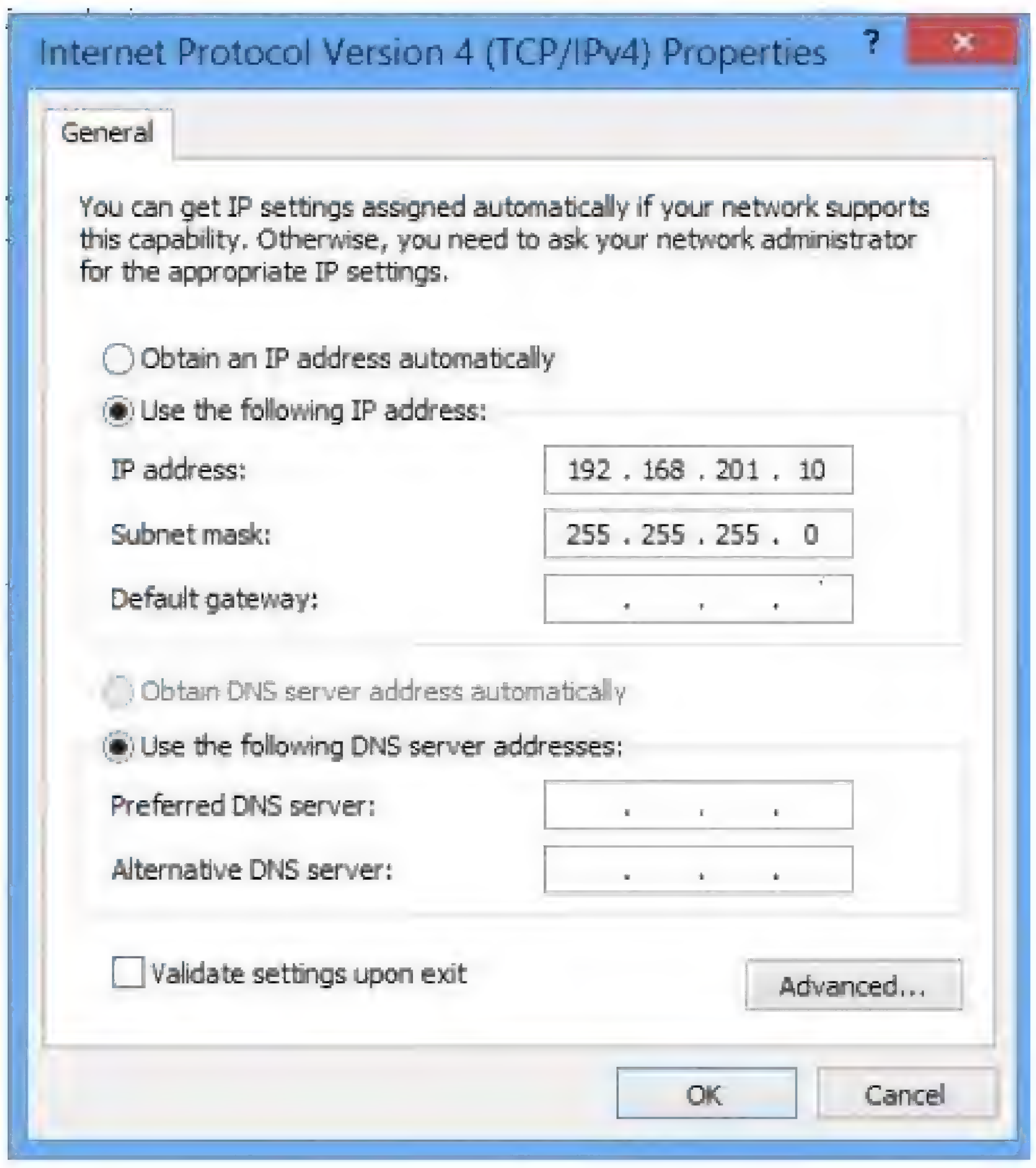
TASK:

- Assigning IPv4 address to computers.
- Verify communication between the same and different network computers.
- Assigning Default Gateway address to computers.
- Verify communication between the different network computers.

Assigning IPv4 Address to computers

On Windows 7 or Windows 8.x or Windows 10 Computer

- Open **Network and Sharing Center**
- Click on **Change adapter settings** and Click **Open.**
- **Right-click** on your local adapter and select **Properties**.
- In the **Local Area Connection Properties** window select **Internet Protocol Version 4 (TCP/IPv4)** then click the **Properties** button.
- Now select the radio button **Use the following IP address** and enter in the IP address and Subnet mask and click **OK**.



- Verify above configured ip address by giving below command.

  C:\> **ipconfig**

  Windows IP Configuration
  Ethernet adapter Ethernet:
  Connection-specific DNS Suffix . :
  IPv4 Address. . . . . : 192.168.201.10
  Subnet Mask . . . . : 255.255.255.0
  Default Gateway . . . . :

- Repeat the above steps to configure ip address on all windows based computers.

On Linux

- Give below command to configure ip address

```
bt ~ # ifconfig eth0 192.168.201.10
```

- To verify the configured ip address by giving below command.

```
bt ~ # ifconfig
eth0      Link encap:Ethernet  HWaddr 00:21:97:73:58:21
          inet addr:192.168.201.10  Bcast:192.168.201.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:171979 errors:0 dropped:0 overruns:0 frame:0
          TX packets:341932 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:12370727 (11.7 MiB)  TX bytes:463457462 (441.9 MiB)
          Interrupt:20 Base address:0xe800

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:18 errors:0 dropped:0 overruns:0 frame:0
          TX packets:18 errors:0 dropped:0 overruns:0 carrier:0
          RX bytes:1796 (1.7 KiB)  TX bytes:1796 (1.7 KiB)
```

- Repeat the above steps to configure ip address on all linux based computers.

Verify communication between the same and different network computers.

From 192.168.201.10 computer (i.e. PC1) ping other computers

ping 192.168.201.20

PING 192.168.201.20 (192.168.201.20) 56(84) bytes of data.
64 bytes from 192.168.201.20: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.201.20: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.201.20: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.201.20: icmp_seq=4 ttl=64 time=24.0 ms

ping 192.168.201.30

PING 192.168.201.30 (192.168.201.30) 56(84) bytes of data.
64 bytes from 192.168.201.30: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.201.30: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.201.30: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.201.30: icmp_seq=4 ttl=64 time=24.0 ms

ping 192.168.202.10

connect: Network is unreachable

From 192.168.202.10 computer (i.e. PC4) ping other computers

ping 192.168.202.20

PING 192.168.202.20 (192.168.202.20) 56(84) bytes of data.
64 bytes from 192.168.202.20: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.202.20: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.202.20: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.202.20: icmp_seq=4 ttl=64 time=24.0 ms

ping 192.168.202.30

PING 192.168.202.30 (192.168.202.30) 56(84) bytes of data.
64 bytes from 192.168.202.30: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.202.30: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.202.30: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.202.30: icmp_seq=4 ttl=64 time=24.0 ms

ping 192.168.201.10

connect: Network is unreachable

From 192.168.201.10 computer (i.e. PC1) trace network communication path to other computers

```
tracert 192.168.201.20 (Windows) or traceroute 192.168.201.20 (Linux)
traceroute to 192.168.201.20 (192.168.201.20), 30 hops max, 38 byte packets
 1  192.168.201.20 (192.168.201.20)  1.456 ms  0.193 ms  0.114 ms
```

```
tracert 192.168.201.30 (Windows) or traceroute 192.168.201.30 (Linux)
traceroute to 192.168.201.30 (192.168.201.30), 30 hops max, 38 byte packets
 1  192.168.201.30 (192.168.201.30)  1.156 ms  0.193 ms  0.114 ms
```

From 192.168.202.10 computer (i.e. PC4) trace network communication path to other computers

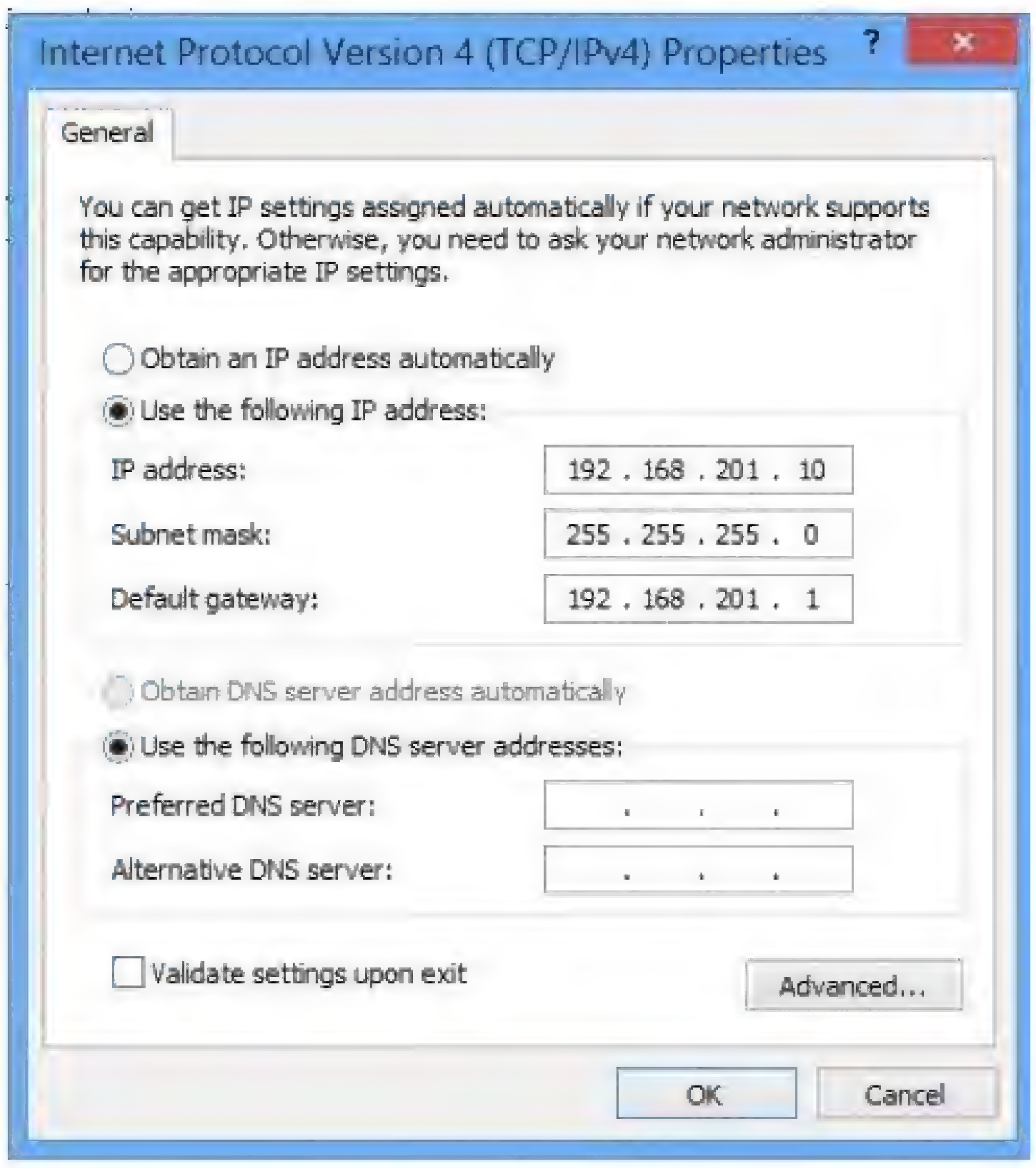
```
tracert 192.168.202.20 (Windows) or traceroute 192.168.202.20 (Linux)
traceroute to 192.168.202.20 (192.168.202.20), 30 hops max, 38 byte packets
 1  192.168.202.20 (192.168.202.20)  1.456 ms  0.193 ms  0.114 ms
```

```
tracert 192.168.202.30 (Windows) or traceroute 192.168.202.30 (Linux)
traceroute to 192.168.202.30 (192.168.202.30), 30 hops max, 38 byte packets
 1  192.168.202.30 (192.168.202.30)  1.156 ms  0.193 ms  0.114 ms
```

Assigning Default Gateway address to computers

On Windows 7 or Windows 8.x or Windows 10 Computer

- Open **Network and Sharing Center**
- Click on **Change adapter settings** and Click **Open.**
- **Right-click** on your local adapter and select **Properties**.
- In the **Local Area Connection Properties** window select **Internet Protocol Version 4 (TCP/IPv4)** then click the **Properties** button.
- Now select the radio button **Use the following IP address** and enter **Default Gateway** and click **OK**.



- Verify above configured default gateway by giving below command.

  C:\> **ipconfig**

  Windows IP Configuration
  Ethernet adapter Ethernet:
  Connection-specific DNS Suffix . :
  IPv4 Address. . . . . : 192.168.201.10
  Subnet Mask . . . . : 255.255.255.0
  Default Gateway . . . . : 192.168.201.1

- Repeat the above steps to configure default gateway on all windows based computers.

On Linux

- Give below command to configure default gateway

```
bt ~ # route add default gw 192.168.201.1
```

- To verify the configure default gateway by giving below command.

```
bt ~ # route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
192.168.201.0   0.0.0.0         255.255.255.0   U     0      0        0 eth0
127.0.0.0       0.0.0.0         255.0.0.0       U     0      0        0 lo
0.0.0.0         192.168.201.1   0.0.0.0         UG    0      0        0 eth0
```

- Repeat the above steps to configure default gateway on all linux based computers.

Verify communication between the different network computers.

From 192.168.201.10 computer (i.e. PC1) ping other computers

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=63 time=24.0 ms

ping 192.168.202.20

PING 192.168.202.20 (192.168.202.20) 56(84) bytes of data.
64 bytes from 192.168.202.20: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.202.20: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.202.20: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.202.20: icmp_seq=4 ttl=63 time=24.0 ms

ping 192.168.201.30

PING 192.168.202.30 (192.168.202.30) 56(84) bytes of data.
64 bytes from 192.168.202.30: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.202.30: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.202.30: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.202.30: icmp_seq=4 ttl=63 time=24.0 ms

From 192.168.202.10 computer (i.e. PC4) ping other computers

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=63 time=24.0 ms

ping 192.168.201.20

PING 192.168.201.20 (192.168.201.20) 56(84) bytes of data.
64 bytes from 192.168.201.20: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.201.20: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.201.20: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.201.20: icmp_seq=4 ttl=63 time=24.0 ms

ping 192.168.201.30

PING 192.168.201.30 (192.168.201.30) 56(84) bytes of data.
64 bytes from 192.168.201.30: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.201.30: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.201.30: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.201.30: icmp_seq=4 ttl=63 time=24.0 ms

From 192.168.201.10 computer (i.e. PC1) trace network communication path to other computers

```
tracert 192.168.202.10 (Windows) or traceroute 192.168.202.10 (Linux)
traceroute to 192.168.202.10 (192.168.202.10), 30 hops max, 38 byte packets
 1  192.168.201.1 (192.168.201.1)  1.086 ms  1.124 ms  1.144 ms
 2  192.168.202.10 (192.168.202.10)  2.295 ms  2.156 ms  2.209 ms
```

```
tracert 192.168.202.20 (Windows) or traceroute 192.168.202.20 (Linux)
traceroute to 192.168.202.20 (192.168.202.20), 30 hops max, 38 byte packets
 1  192.168.201.1 (192.168.201.1)  1.086 ms  1.124 ms  1.144 ms
 2  192.168.202.20 (192.168.202.20)  2.295 ms  2.156 ms  2.209 ms
```

From 192.168.202.10 computer (i.e. PC4) trace network communication path to other computers

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2  192.168.201.10 (192.168.201.10)  2.295 ms  2.156 ms  2.209 ms
```

```
tracert 192.168.201.20 (Windows) or traceroute 192.168.201.20 (Linux)
traceroute to 192.168.201.20 (192.168.201.20), 30 hops max, 38 byte packets
 1  192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2  192.168.201.20 (192.168.201.20)  2.295 ms  2.156 ms  2.209 ms
```

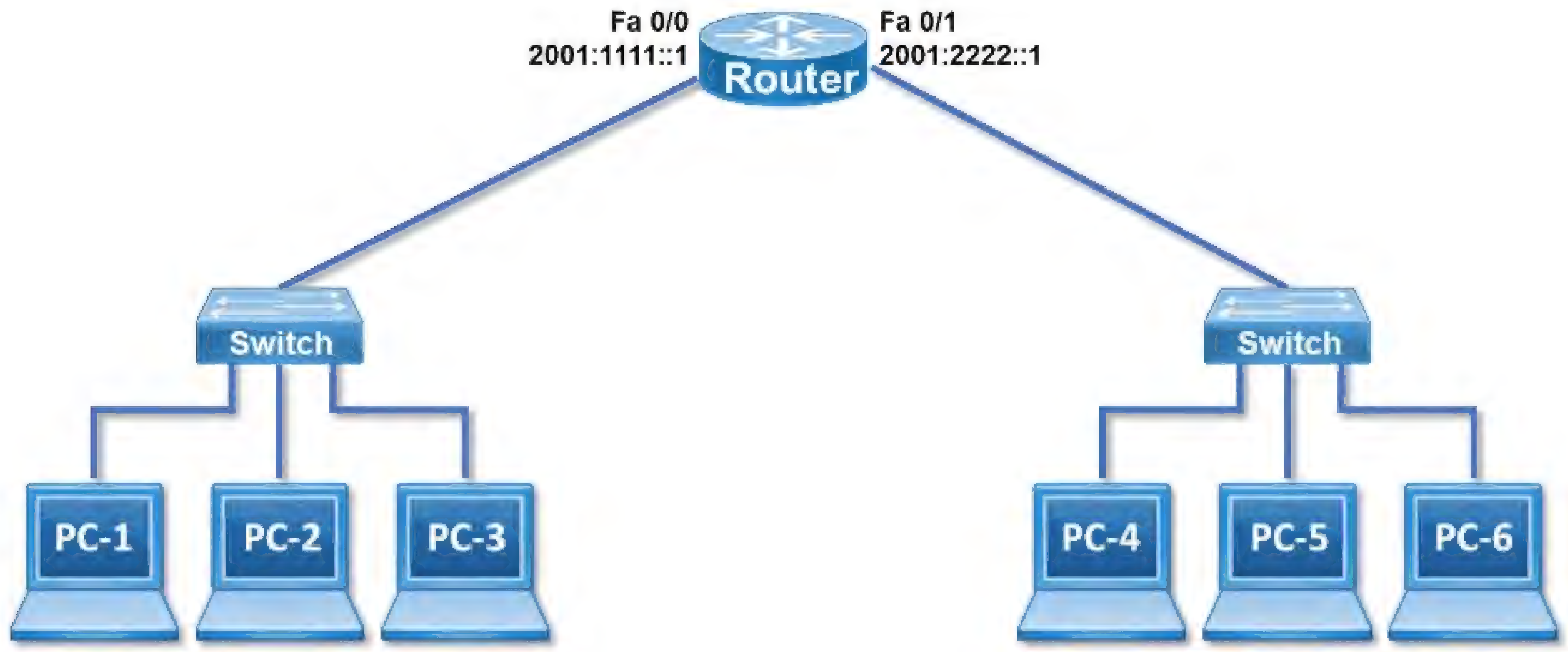
LAB 2: UNDERSTANDING IPv6 NETWORK COMMUNICATION

OBJECTIVE:

To verify communication between same network and different network computers after assigning IPv6 Address and Default Gateway.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Computer	IP Address / Mask
PC-1	2001:1111::10/64
PC-2	2001:1111::20/64
PC-3	2001:1111::30/64

Computer	IP Address / Mask
PC-4	2001:2222::10/64
PC-5	2001:2222::20/64
PC-6	2001:2222::30/64

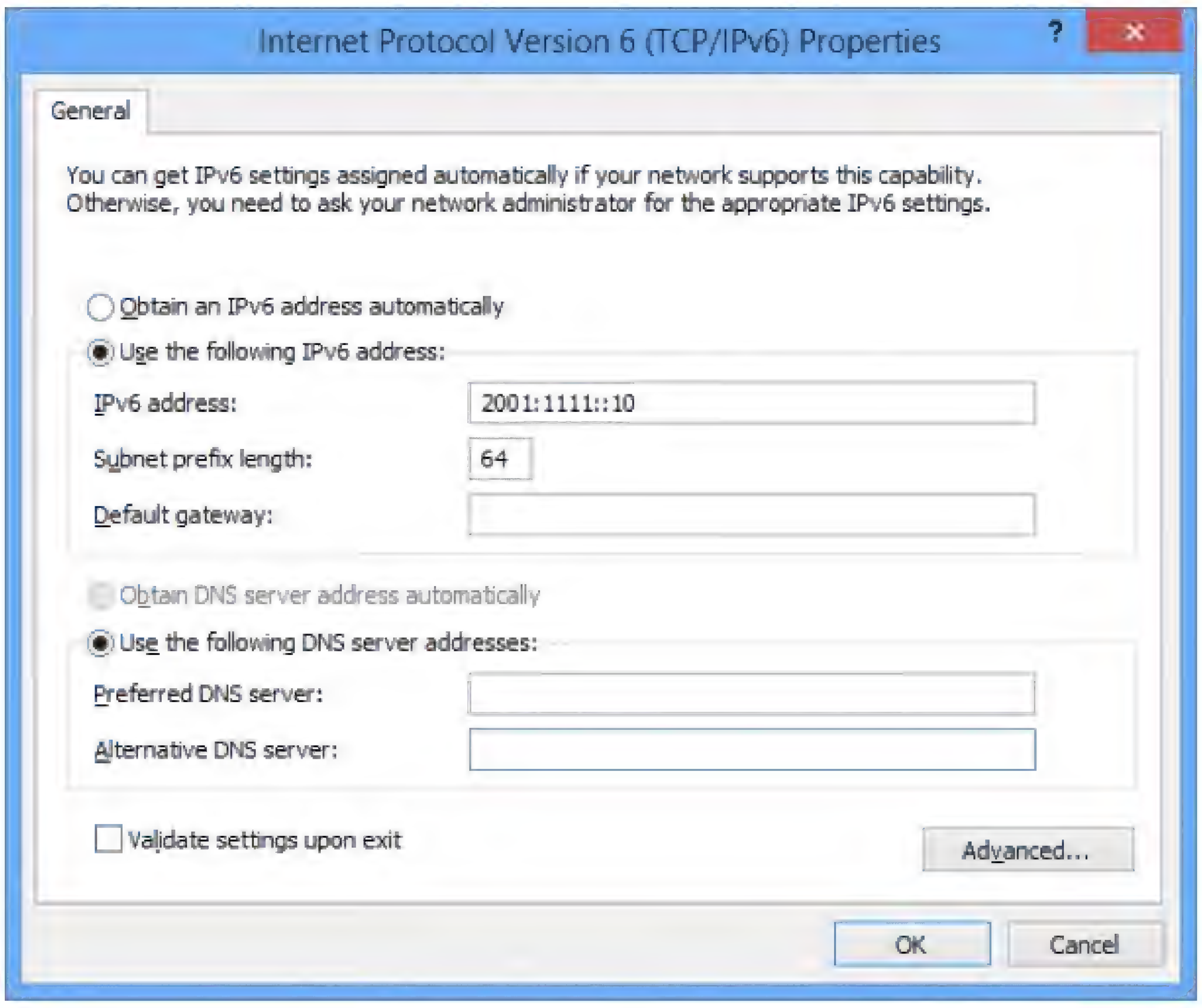
TASK:

- Assigning IPv6 address to computers.
- Verify communication between the same and different network computers.
- Assigning Default Gateway address to computers.
- Verify communication between the different network computers.

Assigning IPv6 Address to computers

On Windows 7 or Windows 8.x or Windows 10 Computer

- Open **Network and Sharing Center**
- Click on **Change adapter settings** and Click **Open.**
- **Right-click** on your local adapter and select **Properties**.
- In the **Local Area Connection Properties** window select **Internet Protocol Version 6 (TCP/IPv6)** then click the **Properties** button.
- Now select the radio button **Use the following IPv6 address** and enter in the IP address and Subnet prefix and click **OK**.



- Verify above configured ip address by giving below command.

  C:\> **ipconfig**

  Windows IP Configuration
  Ethernet adapter Ethernet:
  Connection-specific DNS Suffix . :
  IPv6 Address. . . . . : 2001:1111::10
  Link-local IPv6 Address . . . . : fe80::449d:6a9a:2c80:80dc%64
  Default Gateway . . . . :

- Repeat the above steps to configure ip address on all windows based computers.

On Linux

- Give below command to configure ip address

```
bt ~ # ifconfig eth0 inet6 add 2001:1111::10/64
```

- To verify the configured ipv6 address by giving below command.

```
bt ~ # ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet6 2001:1111::10  prefixlen 64  scopeid 0x0<global>
        ether 44:8a:5b:d4:39:3c  txqueuelen 1000  (Ethernet)
        RX packets 230  bytes 82110 (80.1 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 121  bytes 19549 (19.0 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 0  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

- Repeat the above steps to configure ip address on all linux based computers.

Verify communication between the same and different network computers.

From 2001:1111::10 computer (i.e. PC1) ping other computers

ping 2001:1111::20 (Windows) or ping6 2001:1111::20 (Linux)

PING 2001:1111::20(2001:1111::20) 56 data bytes
64 bytes from 2001:1111::20: icmp_seq=1 ttl=64 time=0.494 ms
64 bytes from 2001:1111::20: icmp_seq=2 ttl=64 time=0.361 ms
64 bytes from 2001:1111::20: icmp_seq=3 ttl=64 time=0.335 ms
64 bytes from 2001:1111::20: icmp_seq=4 ttl=64 time=0.336 ms

ping 2001:1111::30 (Windows) or ping6 2001:1111::30 (Linux)

PING 2001:1111::30(2001:1111::30) 56 data bytes
64 bytes from 2001:1111::30: icmp_seq=1 ttl=64 time=0.494 ms
64 bytes from 2001:1111::30: icmp_seq=2 ttl=64 time=0.361 ms
64 bytes from 2001:1111::30: icmp_seq=3 ttl=64 time=0.335 ms
64 bytes from 2001:1111::30: icmp_seq=4 ttl=64 time=0.336 ms

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

connect: Network is unreachable

From 2001:2222::10 computer (i.e. PC4) ping other computers

ping 2001:2222::20 (Windows) or ping6 2001:2222::20 (Linux)

PING 2001:2222::20(2001:2222::20) 56 data bytes
64 bytes from 2001:2222::20: icmp_seq=1 ttl=64 time=0.494 ms
64 bytes from 2001:2222::20: icmp_seq=2 ttl=64 time=0.361 ms
64 bytes from 2001:2222::20: icmp_seq=3 ttl=64 time=0.335 ms
64 bytes from 2001:2222::20: icmp_seq=4 ttl=64 time=0.336 ms

ping 2001:2222::30 (Windows) or ping6 2001:2222::30 (Linux)

PING 2001:2222::30(2001:2222::30) 56 data bytes
64 bytes from 2001:2222::30: icmp_seq=1 ttl=64 time=0.494 ms
64 bytes from 2001:2222::30: icmp_seq=2 ttl=64 time=0.361 ms
64 bytes from 2001:2222::30: icmp_seq=3 ttl=64 time=0.335 ms
64 bytes from 2001:2222::30: icmp_seq=4 ttl=64 time=0.336 ms

ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)

connect: Network is unreachable

From 2001:1111::10 computer (i.e. PC1) trace network communication path to other computers

```
tracert 2001:1111::20 (Windows) or traceroute6 2001:1111::20 (Linux)
traceroute to 2001:1111::20 (2001:1111::20) from 2001:1111::10, 30 hops max,16 byte
 1  2001:1111::20 (2001:1111::20)  3005.56 ms !H  3006.88 ms !H  3005.99
```

```
tracert 2001:1111::30 (Windows) or traceroute6 2001:1111::30 (Linux)
traceroute to 2001:1111::30 (2001:1111::30) from 2001:1111::10, 30 hops max,16 byte
 1  2001:1111::30 (2001:1111::20)  3005.56 ms !H  3006.88 ms !H  3005.99
```

From 2001:2222::10 computer (i.e. PC4) trace network communication path to other computers

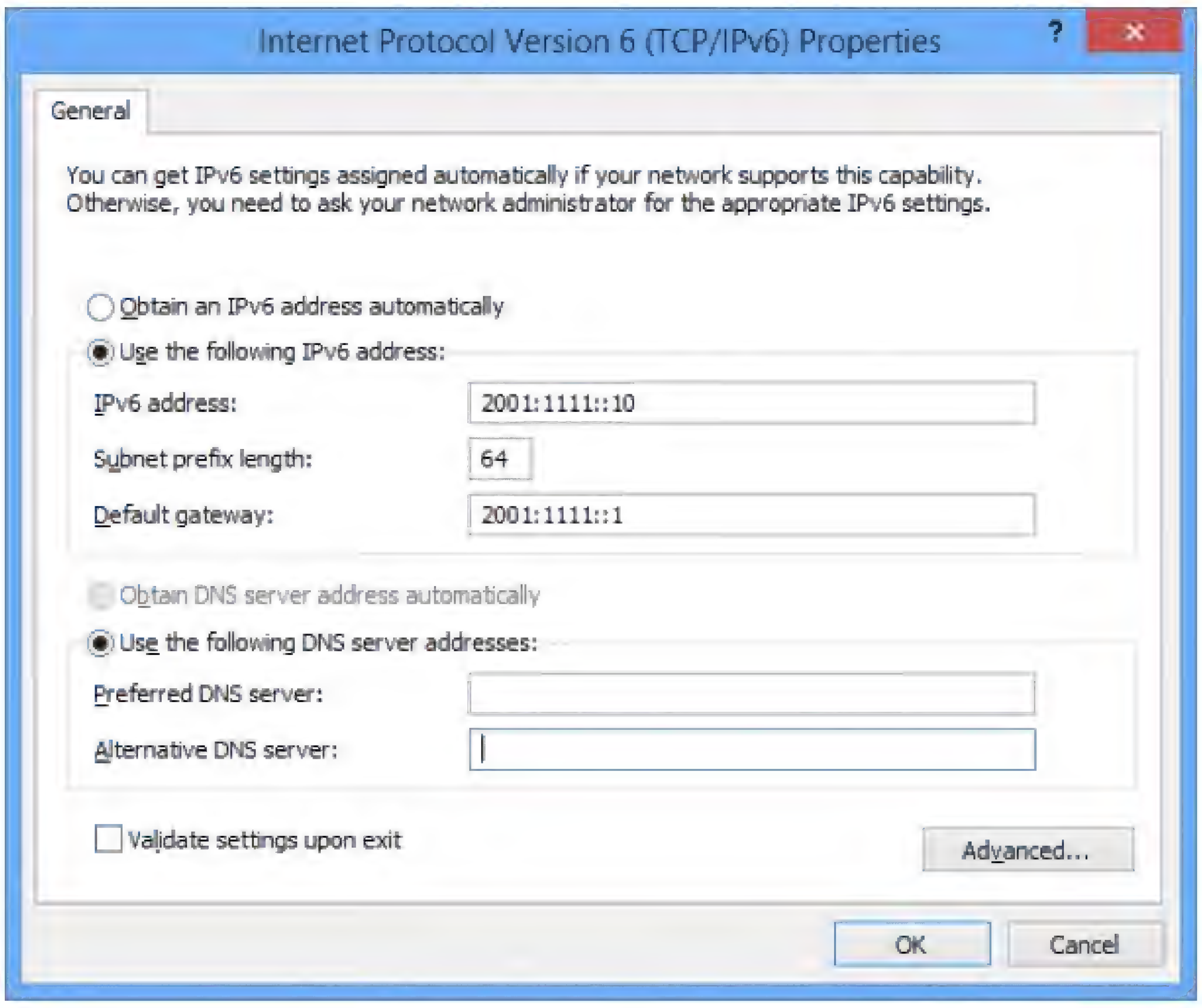
```
tracert 2001:2222::20 (Windows) or traceroute6 2001:2222::20 (Linux)
traceroute to 2001:2222::20 (2001:2222::20) from 2001:2222::10, 30 hops max,16 byte
 1  2001:2222::20 (2001:2222::20)  3005.56 ms !H  3006.88 ms !H  3005.99
```

```
tracert 2001:2222::30 (Windows) or traceroute6 2001:2222::30 (Linux)
traceroute to 2001:2222::30 (2001:2222::30) from 2001:2222::10, 30 hops max,16 byte
 1  2001:2222::30 (2001:2222::20)  3005.56 ms !H  3006.88 ms !H  3005.99
```

Assigning Default Gateway address to computers

On Windows 7 or Windows 8.x or Windows 10 Computer

- Open **Network and Sharing Center**
- Click on **Change adapter settings** and Click **Open.**
- **Right-click** on your local adapter and select **Properties**.
- In the **Local Area Connection Properties** window select **Internet Protocol Version 6 (TCP/IPv6)** then click the **Properties** button.
- Now select the radio button **Use the following IPv6 address** and enter **Default Gateway** and click **OK**.



- Verify above configured default gateway by giving below command.

  C:\> **ipconfig**

  Windows IP Configuration
  Ethernet adapter Ethernet:
  Connection-specific DNS Suffix . :
  IPv6 Address. . . . . : 2001:1111::10
  Link-local IPv6 Address . . . . : fe80::449d:6a9a:2c80:80dc%64
  Default Gateway . . . . : 2001:1111::1

- Repeat the above steps to configure default gateway on all windows based computers.

On Linux

- Give below command to configure default gateway

```
bt ~ # route -6 add default gw 2001:1111::1
```

- To verify the configure default gateway by giving below command.

```
bt ~ # route -6
Kernel IPv6 routing table
Destination                    Next Hop                   Flag Met Ref Use If
::1/128                        ::                         Un   0   1     0 lo
2001:1111::/64                 ::                         U    256 0     2 eth0
fe80::468a:5bff:fed4:3899/128  ::                         Un   0   1     0 lo
fe80::/64                      ::                         U    256 0     0 eth0
ff00::/8                       ::                         U    256 0     0 eth0
::/0                           2001:1111::1               UG   1   0     0 eth0
bt ~ #
```

- Repeat the above steps to configure default gateway on all linux based computers.

Verify communication between the different network computers.

From 2001:1111::10 computer (i.e. PC1) ping other computers

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=63 time=0.336 ms

ping 2001:2222::20 (Windows) or ping6 2001:2222::20 (Linux)

PING 2001:2222::20(2001:2222::20) 56 data bytes
64 bytes from 2001:2222::20: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:2222::20: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:2222::20: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:2222::20: icmp_seq=4 ttl=63 time=0.336 ms

ping 2001:2222::30 (Windows) or ping6 2001:2222::30 (Linux)

PING 2001:2222::30(2001:2222::30) 56 data bytes
64 bytes from 2001:2222::30: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:2222::30: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:2222::30: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:2222::30: icmp_seq=4 ttl=63 time=0.336 ms

From 2001:2222::10 computer (i.e. PC4) ping other computers

ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)

PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=63 time=0.336 ms

ping 2001:1111::20 (Windows) or ping6 2001:1111::20 (Linux)

PING 2001:1111::20(2001:1111::20) 56 data bytes
64 bytes from 2001:1111::20: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:1111::20: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:1111::20: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:1111::20: icmp_seq=4 ttl=63 time=0.336 ms

ping 2001:1111::30 (Windows) or ping6 2001:1111::30 (Linux)

PING 2001:1111::30(2001:1111::30) 56 data bytes
64 bytes from 2001:1111::30: icmp_seq=1 ttl=63 time=0.494 ms
64 bytes from 2001:1111::30: icmp_seq=2 ttl=63 time=0.361 ms
64 bytes from 2001:1111::30: icmp_seq=3 ttl=63 time=0.335 ms
64 bytes from 2001:1111::30: icmp_seq=4 ttl=63 time=0.336 ms

From 2001:1111::10 computer (i.e. PC1) trace network communication path to other computers

```
tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)
traceroute to 2001:2222::10 (2001:2222::10) from 2001:1111::10, 30 hops max,16 byte
 1  2001:1111::1 (2001:1111::1)  1.12 ms  1.012 ms  1.039 ms
 2  2001:2222::10 (2001:2222::10)  1.111 ms  0.884 ms  0.861 ms
```

```
tracert 2001:2222::20 (Windows) or traceroute6 2001:2222::20 (Linux)
traceroute to 2001:2222::20 (2001:2222::20) from 2001:1111::10, 30 hops max,16 byte
 1  2001:1111::1 (2001:1111::1)  1.12 ms  1.012 ms  1.039 ms
 2  2001:2222::20 (2001:2222:10)  1.111 ms  0.884 ms  0.861 ms
```

From 2001:2222::10 computer (i.e. PC4) trace network communication path to other computers

```
tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)
traceroute to 2001:1111::10 (2001:1111::10) from 2001:2222::10, 30 hops max,16 byte
 1  2001:2222::1 (2001:2222::1)  1.12 ms  1.012 ms  1.039 ms
 2  2001:1111::10 (2001:1111::10)  1.111 ms  0.884 ms  0.861 ms
```

```
tracert 2001:1111::20 (Windows) or traceroute6 2001:1111::20 (Linux)
traceroute to 2001:1111::20 (2001:1111::20) from 2001:2222::10, 30 hops max,16 byte
 1  2001:2222::1 (2001:2222::1)  1.12 ms  1.012 ms  1.039 ms
 2  2001:1111::20 (2001:1111:10)  1.111 ms  0.884 ms  0.861 ms
```

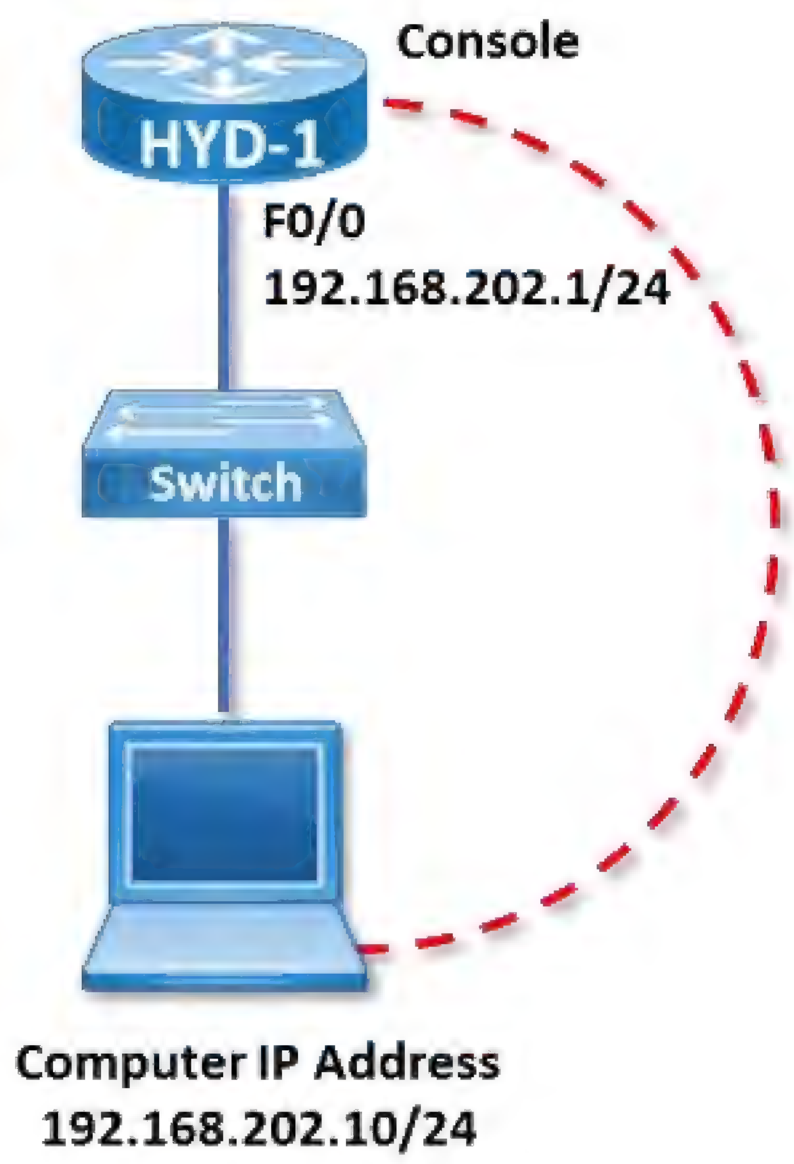
LAB 3: INITIAL CONFIGURATION OF ROUTER - IPv4 NETWORK

OBJECTIVE:

To get familiarized with Cisco IOS modes and configure a new Router with basic configuration i.e. assign IPv4 address on the interfaces and configure passwords etc.

TOPOLOGY:

Setup Console and Ethernet connectivity for the lab as below :

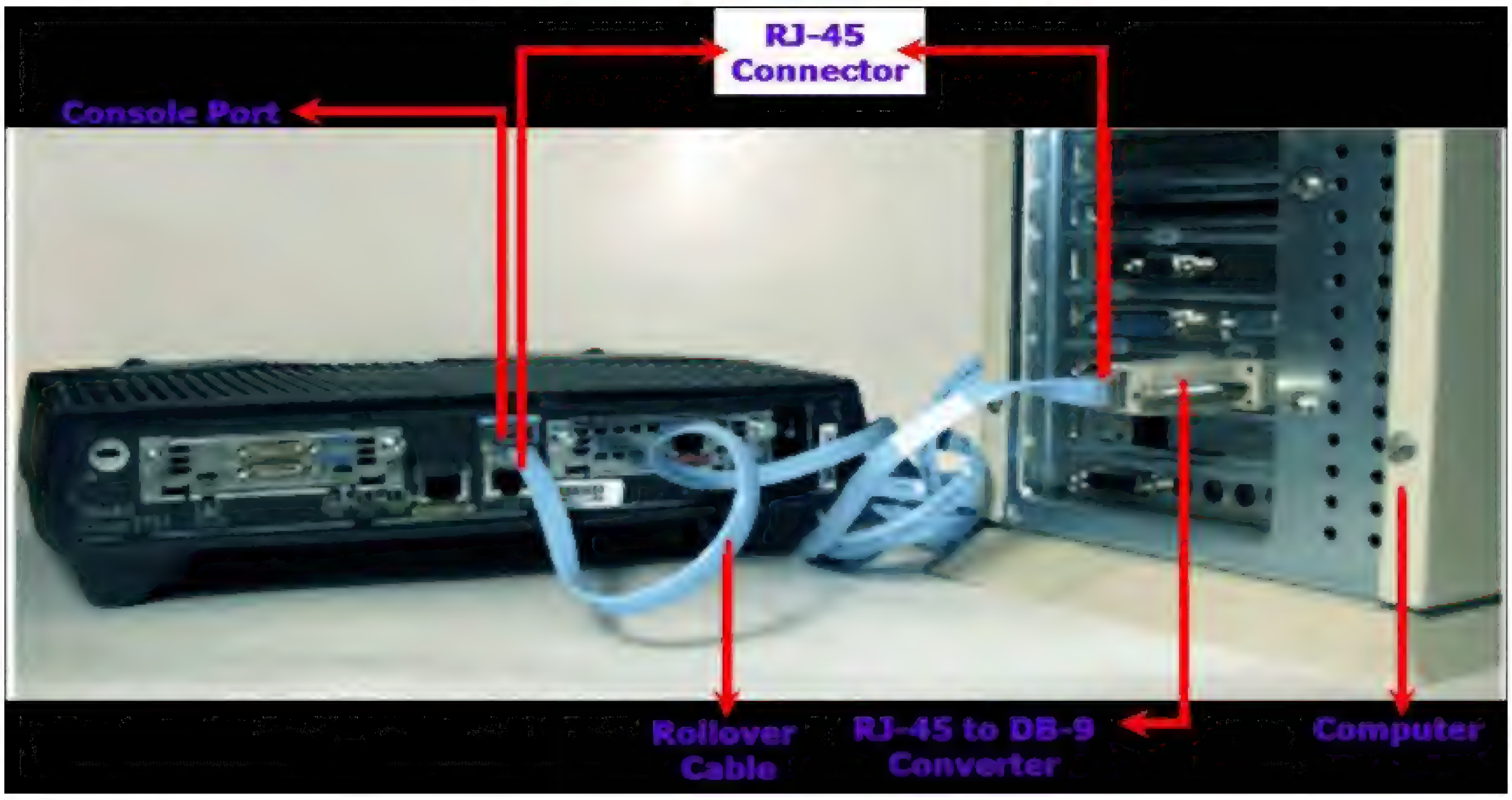


TASK:

- Establish console connectivity
- Access router via console with an emulation software
- Get to know Cisco IOS Modes and Show commands
- Configure Hostname and Interface IP address
- Configure Connectivity Passwords
- Configure Privilege Mode / Enable Password
- Verify configuration in RAM and NVRAM
- Saving configuration to the router
- Access the router via Telnet

Establish console connectivity

Establish console connectivity by connecting Router console port to PC Com Port with console cable as shown in the picture below:



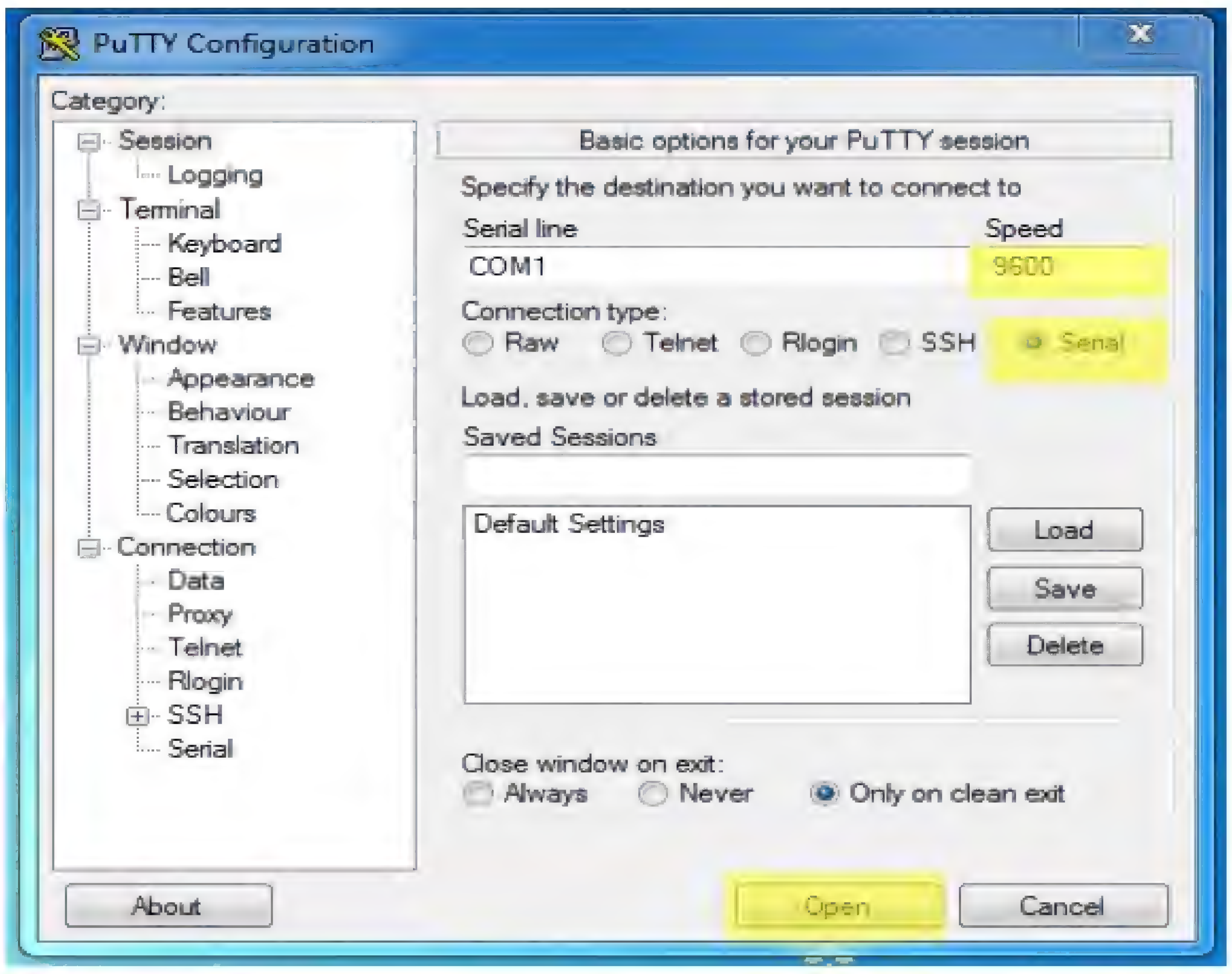
Access router via console with an emulation software

Configure the following parameters in emulation software for accessing router via console port.

Parameters	Console Port Settings
Baud	9600
Data bits	8
Parity	None
Stop bits	1

Accessing router via console from Microsoft Windows Computer

- Start a terminal emulator application, such as **PUTTY.exe**
- Select **Serial** option and set speed to **9600.**
- Click **Open**

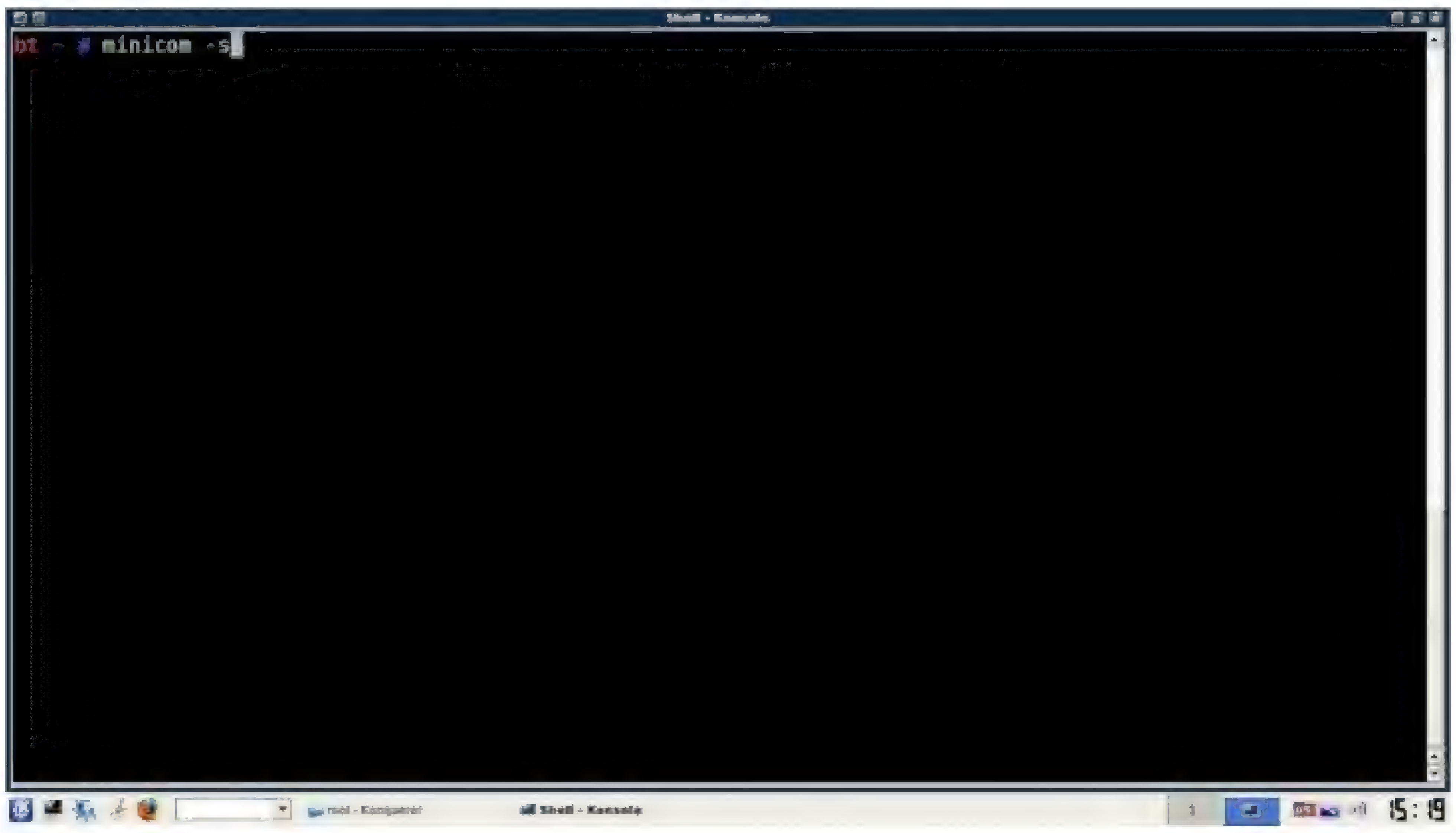


- Once emulation software is ready, **Power-ON** the Router.

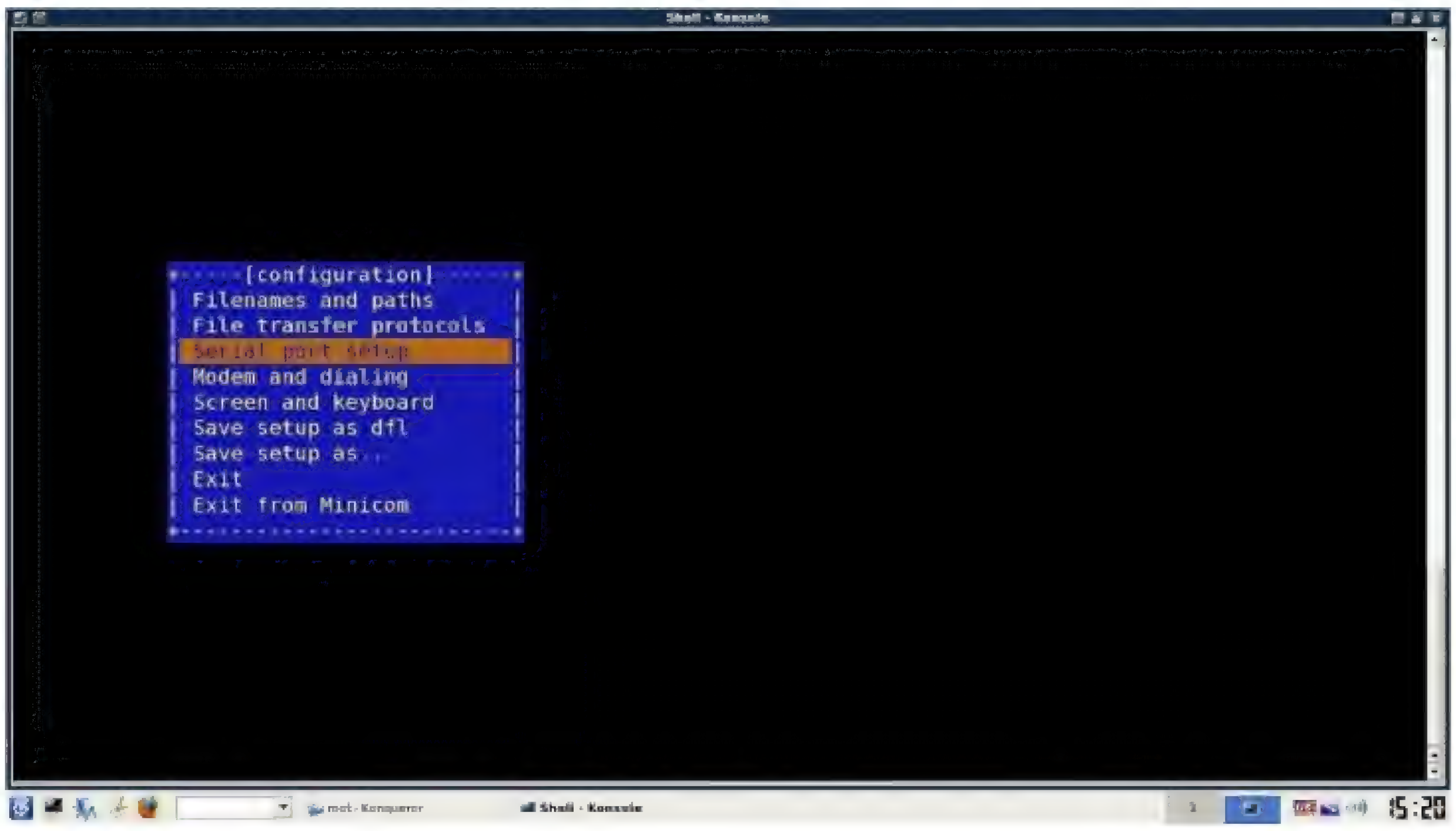
Accessing router via console from Linux Computer

- From the terminal enter the below command

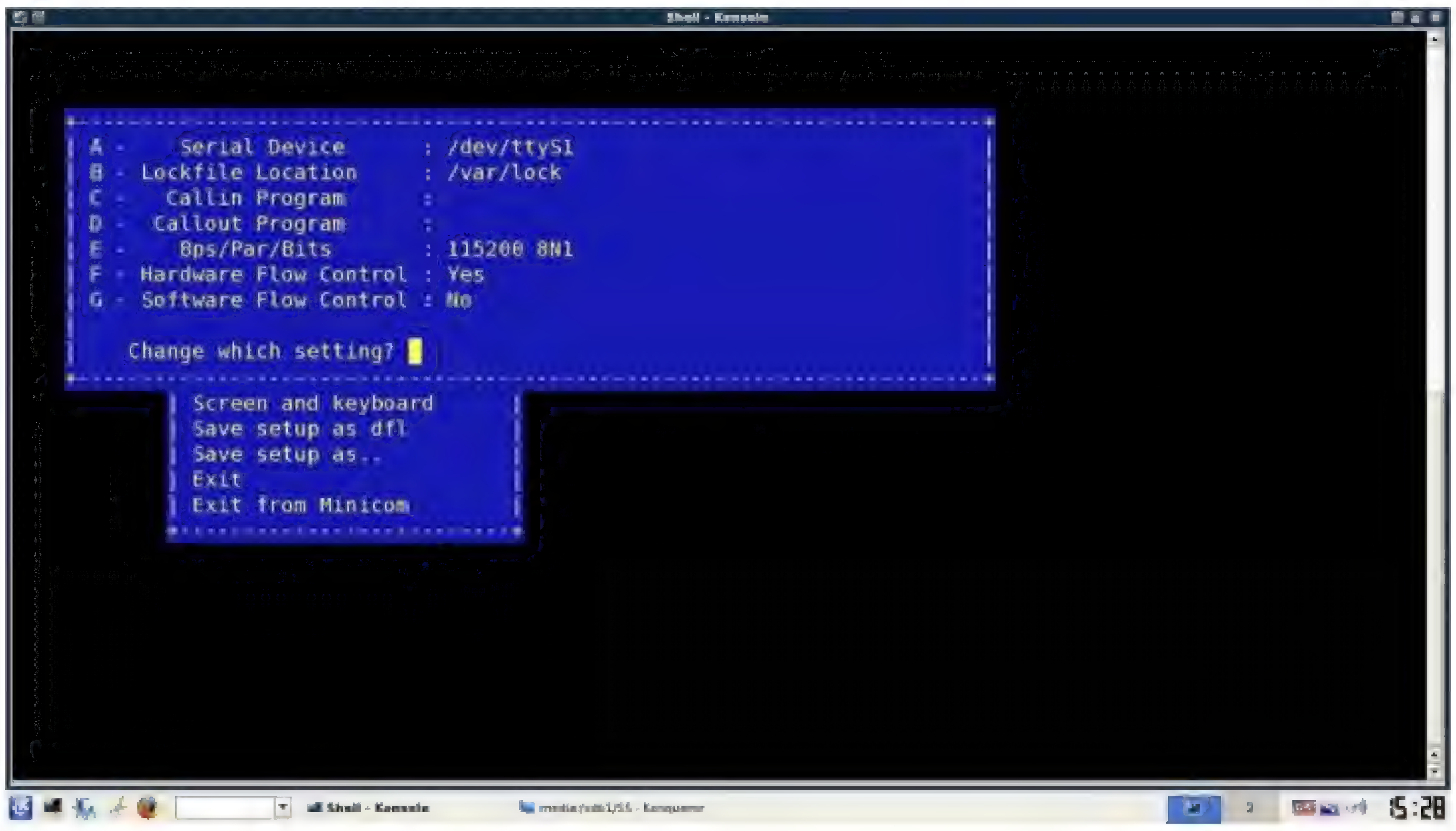
  # **minicom –s**



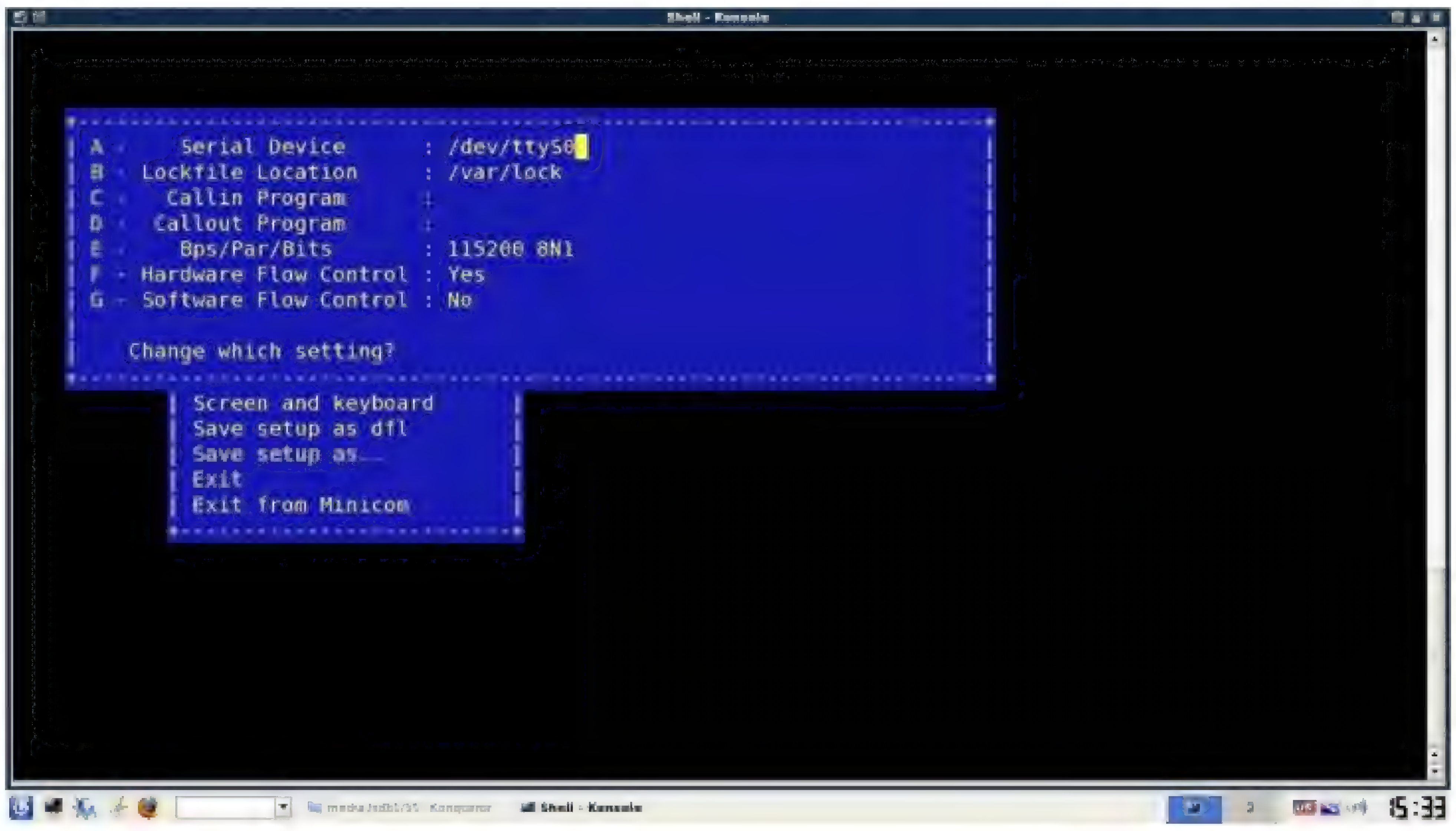
- Select Serial port Setup and press enter



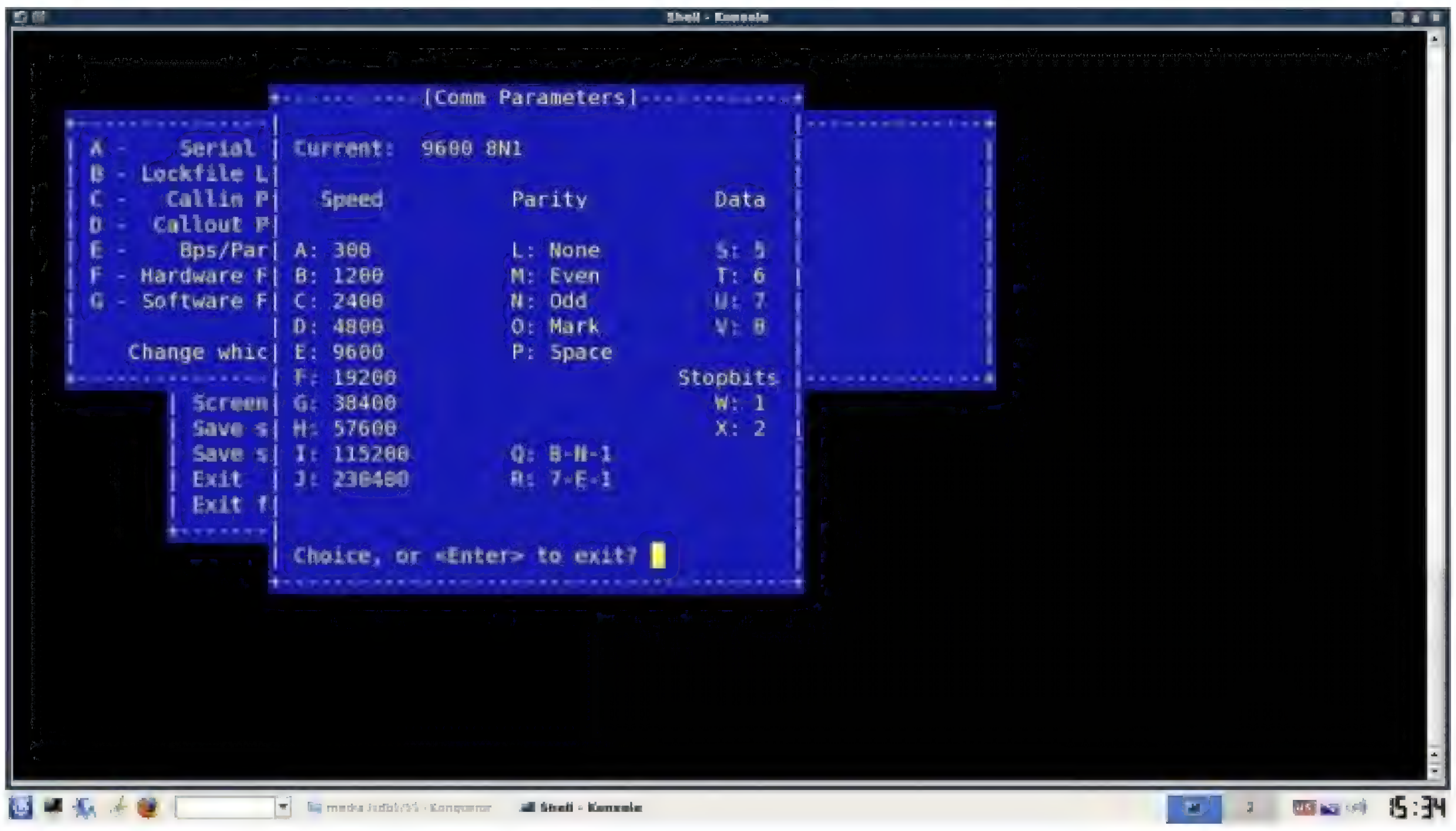
- It will display default **COM Port Settings.**



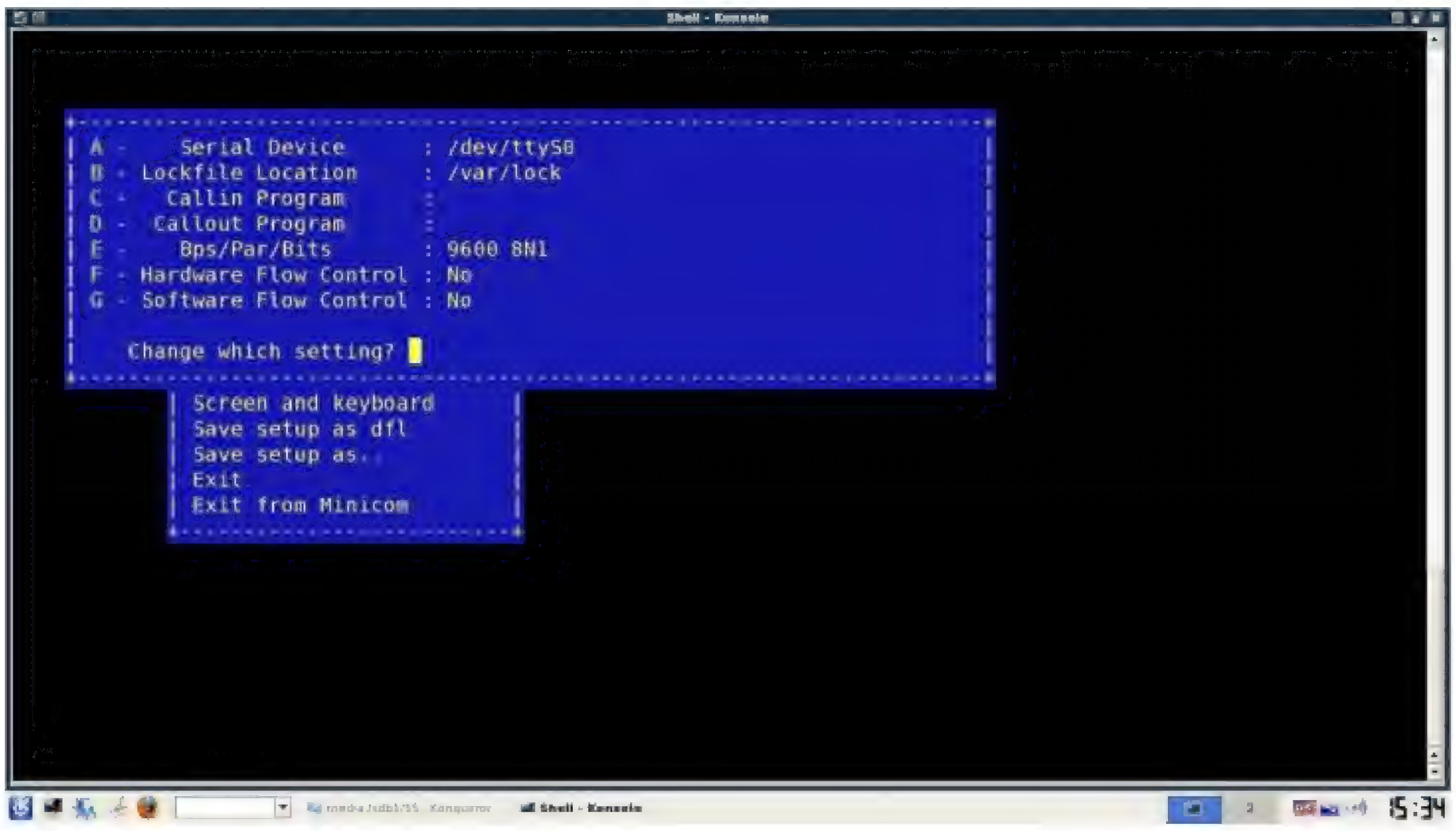
- Specify **COM Port** where console cable is connected by pressing **"a"** and use backspace to delete **"1"** and add **"0"**.



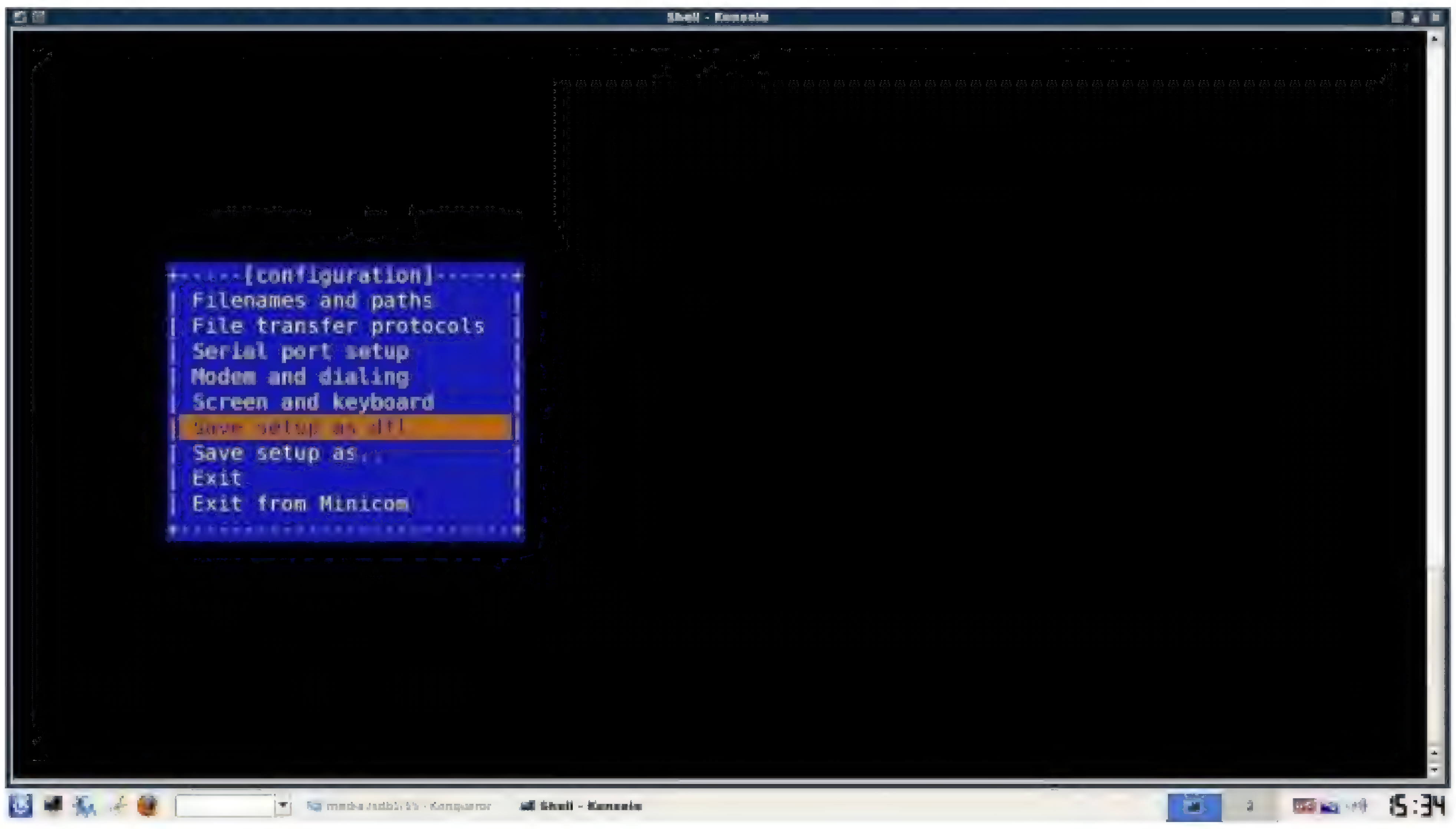
- Change the **Bps Setting** to **9600** by pressing **"e"** and select the alphabet matching to speed **"9600"**.



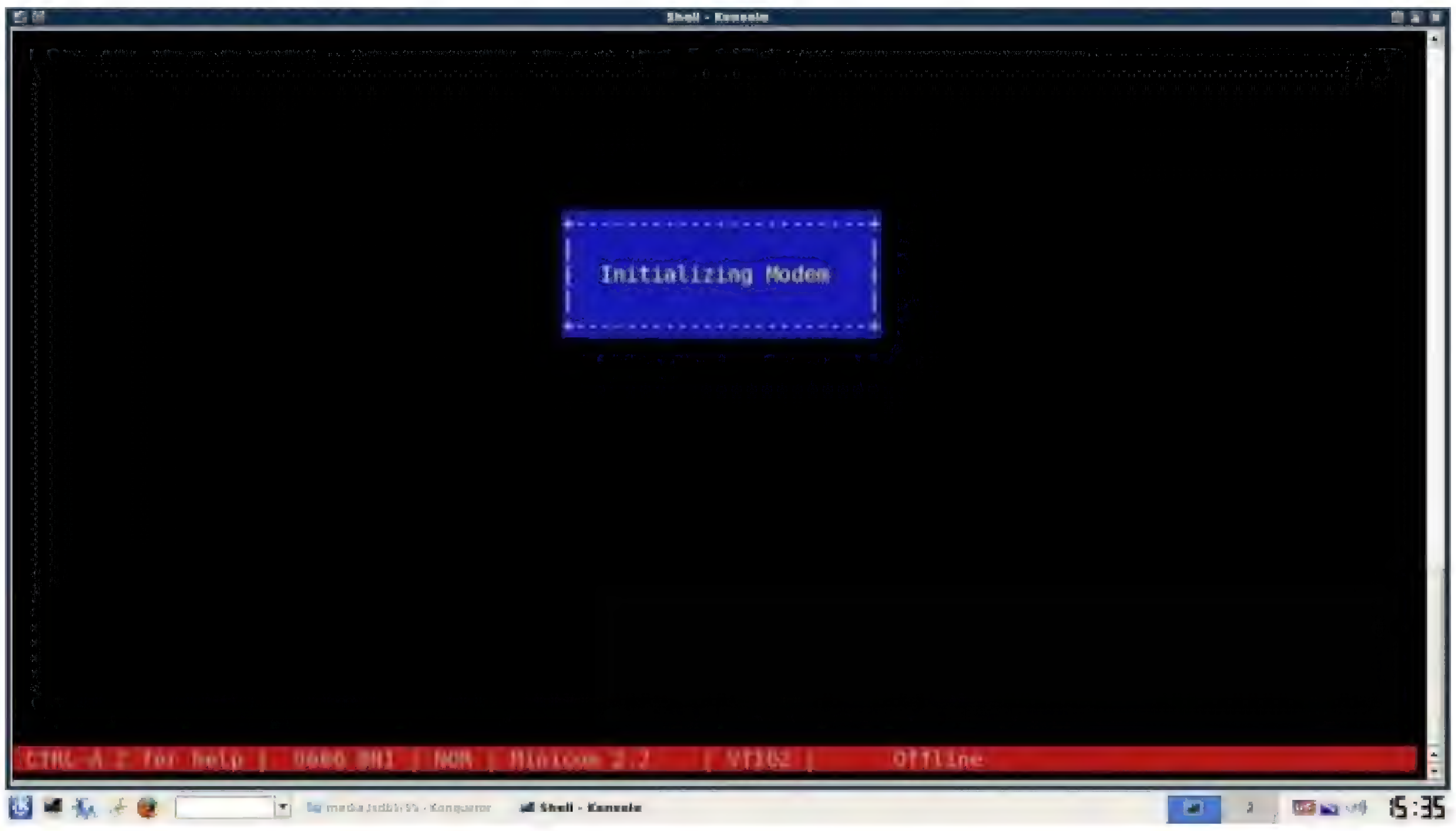
- Change the **Hardware Flow Control** option to **No** by pressing **"F"**.



- Select **Save Setup as dfl** option.



- Select "**Exit**" option.



- Once emulation software is ready, **Power-ON** the Router.

Get to know Cisco IOS Modes and Show commands

After the Router boots-up completely, (on a new Cisco Router) it enters setup mode as below:

--- System Configuration Dialog ---
Would you like to enter the initial configuration dialog? [yes/no]: **no**
Would you like to terminate autoinstall? [yes]: **yes**

If you choose "Yes", IOS will prompt questions to gather the information to configure the Router, it is recommended to choose "no", since we can configure the Router using IOS commands

Router >

To navigate into Privilege mode/Executive Mode from User Mode and Vice-Versa

Router>**enable**
Router #

Router# **disable**
Router >

To view router IOS and hardware information

Router # **show version**

```
Cisco IOS Software, 2800 Software (C2800NM-ADVENTERPRISEK9-M), Version 15.1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2015 by Cisco Systems, Inc.
Compiled Tue 24-Mar-15 09:00 by prod_rel_team

ROM: System Bootstrap, Version 12.4(13r)T, RELEASE SOFTWARE (fc1)

Router uptime is 56 minutes
System returned to ROM by reload at 08:19:55 UTC Sat Jul 9 2016
System image file is "flash:c2800nm-adventerprisek9-mz.151-4.M10.bin"
Last reload type: Normal Reload

This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be fou:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco 2811 (revision 1.0) with 249856K/12288K bytes of memory.
Processor board ID FHK1109F34X
2 FastEthernet interfaces
2 Serial(sync/async) interfaces
1 Virtual Private Network (VPN) Module
DRAM configuration is 64 bits wide with parity enabled.
239K bytes of non-volatile configuration memory.
125440K bytes of ATA CompactFlash (Read/Write)

License Info:
License UDI:
-------------------------------------------------
Device#   PID          SN
-------------------------------------------------
*0        CISCO2811    FHK1109F34X

Configuration register is 0x2102

Router#
```

To view router flash Information

Router # **show flash**

```
-#- ---length--- -----date/time------ path
1              1 Jan 1 2016 13:54:52 +00:00 redirect.out
2    67926080 Sep 5 2015 14:59:38 +00:00 c2800nm-adventerprisek9-mz.151n

60235776 bytes available (67932160 bytes used)
```

To view router current configuration (RAM)

Router # **show running-config**

```
Current configuration : 1010 bytes
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Router
!
boot-start-marker
boot-end-marker
!
no aaa new-model!
dot11 syslog
ip source-route!
ip cef
!
no ipv6 cef
!
multilink bundle-name authenticated!
!
crypto pki token default removal timeout 0
!
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
```

```
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
!
interface Serial0/0/1
 no ip address
 shutdown
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
control-plane
!
mgcp profile default
line con 0
line aux 0
line vty 0 4
 login
 transport input all
!
scheduler allocate 20000 1000
end

Router#
```

To view router startup configuration (NVRAM)

Router# **show startup-config**

startup-config is not present

To navigate into Global Configuration Mode

Router # **configure terminal**
Router (config) #

Configure Hostname and Interface IP address

To change the Host Name of Router

Router (config) # **hostname HYD-1**
HYD-1 (config) #
To configure IP address on Ethernet Interface (LAN interface)

HYD-1 (config) # **interface Fastethernet 0/0**
HYD-1 (config-if) # **ip address 192.168.202.1 255.255.255.0**
HYD-1 (config-if) # **no shutdown**
HYD-1 (config-if) # **exit**

Configure Connectivity Passwords

To configure telnet password

HYD-1 (config) # **line vty 0 4**
HYD-1 (config-line) # **password zoom**
HYD-1 (config-line) # **login**
HYD-1 (config-line) # **exit**

To configure console password

HYD-1 (config) # **line console 0**
HYD-1 (config-line) # **password ccna**
HYD-1 (config-line) # **login**
HYD-1 (config-line) # **exit**

To configure auxiliary password

HYD-1 (config) # **line aux 0**
HYD-1 (config-line) # **password cisco**
HYD-1 (config-line) # **login**
HYD-1 (config-line) # **exit**

Configure Privilege Mode / Enable Password

Configure privilege password

HYD-1 (config) # **enable password ccna**
HYD-1 (config) # **enable secret zoom**

Verify configuration in RAM and NVRAM

To View Router Current Configuration (RAM)

HYD-1 # **show running-config**

Current configuration : 1241 bytes
!
Last configuration change at 08:37:39 UTC Sat Jul 9 2016
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname HYD-1
!
boot-start-marker
boot-end-marker
!

```
!
enable secret 5 $1$DMgk$lTC7TUZVwFn5969wEB2mw.
enable password ccna
!
no aaa new-model
!
dot11 syslog
ip source-route
!
ip cef
!
no ipv6 cef
!
multilink bundle-name authenticated
crypto pki token default removal timeout 0
!
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
 ip address 192.168.202.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
!
interface Serial0/0/1
 no ip address
 shutdown
!
ip forward-protocol nd
no ip http server
no ip http secure-server!
control-plane
!
mgcp profile default
!
!
!
!
!
```

```
!
line con 0
 password ccna
 login
line aux 0
 password cisco
 login
line vty 0 4
 password zoom
 login
 transport input all
!
scheduler allocate 20000 1000
end
```

To View Router Startup Configuration (NVRAM)

HYD-1 # **show startup-config**

startup-config is not present

Saving configuration to the router

To save configuration on router

HYD-1 # **write memory**

```
Destination filename [startup-config]?
Building configuration...

[OK]
HYD-1 #
```

To view router startup configuration (NVRAM)

HYD-1 # **show startup-config**

```
Current configuration : 1241 bytes
!
Last configuration change at 08:40:39 UTC Sat Jul 9 2016
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname HYD-1
!
boot-start-marker
boot-end-marker
!
!
```

```
enable secret 5 $1$DMgk$ITC7TUZVwFn5969wEB2mw.
enable password ccna
!
no aaa new-model
!
dot11 syslog
ip source-route
!
ip cef
!
no ipv6 cef
!
multilink bundle-name authenticated
crypto pki token default removal timeout 0
!
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
 ip address 192.168.202.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
!
interface Serial0/0/1
 no ip address
 shutdown
!
!
ip forward-protocol nd
no ip http server
no ip http secure-server!
control-plane
!
!
mgcp profile default!
!
line con 0
 password ccna
 login
```

```
line aux 0
 password cisco
 login
line vty 0 4
 password zoom
 login
 transport input all
!
scheduler allocate 20000 1000
end
```

Access the router via Telnet

- Accessing router via telnet by giving below command on a Windows or Linux computer.

  telnet 192.168.202.1

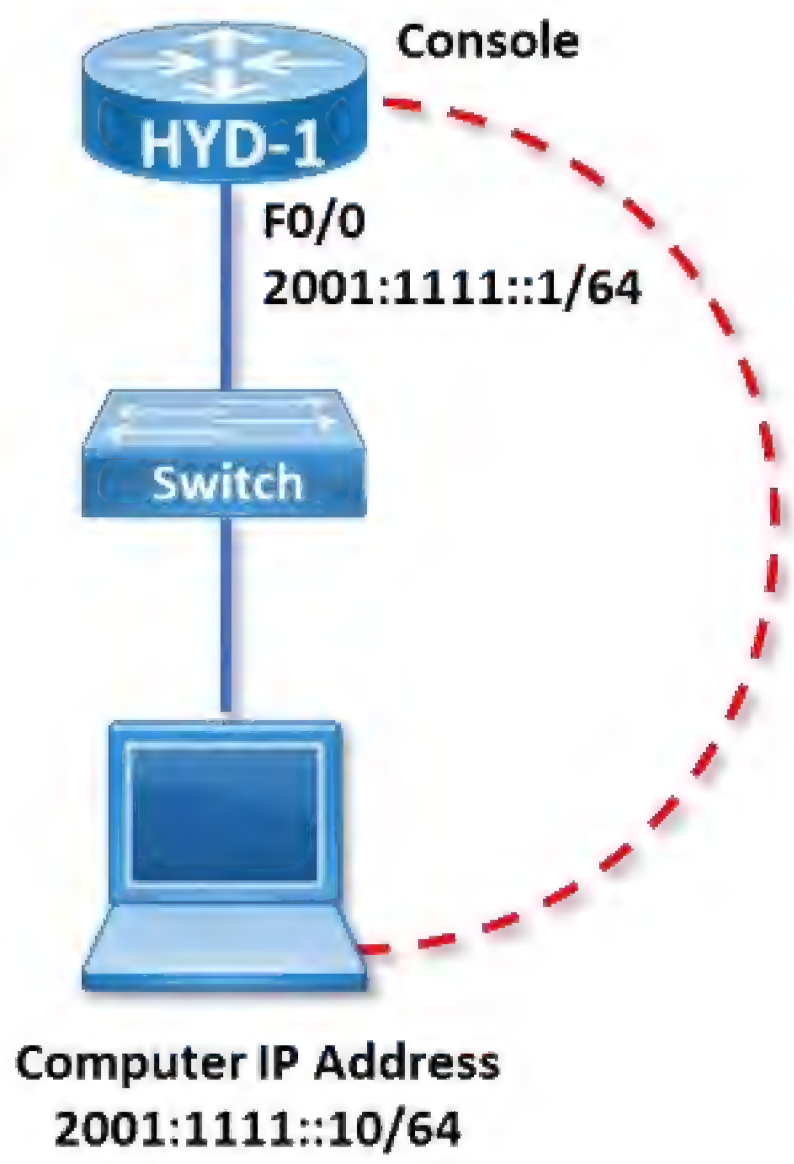
LAB 4: INITIAL CONFIGURATION OF ROUTER – IPv6 NETWORK

OBJECTIVE:

To get familiarized with Cisco IOS modes and configure a new Router with basic configuration i.e. assign IPv6 address on the interfaces and configure passwords etc.

TOPOLOGY:

Setup Console and Ethernet connectivity for the lab as below :



TASK:

- Establish console connectivity
- Access router via console with an emulation software
- Get to know Cisco IOS Modes and Show commands
- Configure Hostname and Interface IP address
- Configure Connectivity Passwords
- Configure Privilege Mode / Enable Password
- Verify configuration in RAM and NVRAM
- Saving configuration to the router
- Access the router via Telnet

Establish console connectivity

Refer page no. 36 for how to establish console connectivity.

Access router via console with an emulation software

Refer page no. 36 for accessing Router via console port .

Get to know Cisco IOS Modes and Show commands

After the Router boots-up completely, (on a new Cisco Router) it enters setup mode as below:

--- System Configuration Dialog ---
Would you like to enter the initial configuration dialog? [yes/no]: **no**
Would you like to terminate autoinstall? [yes]: **yes**

If you choose "Yes", IOS will prompt questions to gather the information to configure the Router, it is recommended to choose "no", since we can configure the Router using IOS commands

Router >

To navigate into Privilege mode/Executive Mode from User Mode and Vice-Versa

Router>**enable**
Router #

Router# **disable**
Router >

To view router IOS and hardware information

Router # **show version**

Cisco IOS Software, 2800 Software (C2800NM-ADVENTERPRISEK9-M), Version 15.1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2015 by Cisco Systems, Inc.
Compiled Tue 24-Mar-15 09:00 by prod_rel_team

ROM: System Bootstrap, Version 12.4(13r)T, RELEASE SOFTWARE (fc1)

Router uptime is 56 minutes
System returned to ROM by reload at 08:19:55 UTC Sat Jul 9 2016
System image file is "flash:c2800nm-adventerprisek9-mz.151-4.M10.bin"
Last reload type: Normal Reload

This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be fou:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco 2811 (revision 1.0) with 249856K/12288K bytes of memory.
Processor board ID FHK1109F34X
2 FastEthernet interfaces
2 Serial(sync/async) interfaces
1 Virtual Private Network (VPN) Module
DRAM configuration is 64 bits wide with parity enabled.
239K bytes of non-volatile configuration memory.
125440K bytes of ATA CompactFlash (Read/Write)

License Info:
License UDI:
```
-------------------------------------------------
Device#   PID             SN
-------------------------------------------------
*0        CISCO2811       FHK1109F34X
```

Configuration register is 0x2102

Router#

To view router flash Information

Router # **show flash**
```
-#- ---length--- -----date/time------ path
1            1 Jan 1 2016 13:54:52 +00:00 redirect.out
2     67926080 Sep 5 2015 14:59:38 +00:00 c2800nm-adventerprisek9-mz.151n
```

60235776 bytes available (67932160 bytes used)

To view router current configuration (RAM)

```
Router # show running-config
Current configuration : 1010 bytes
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Router
!
boot-start-marker
boot-end-marker
!
no aaa new-model!
dot11 syslog
ip source-route!
ip cef
!
no ipv6 cef
!
multilink bundle-name authenticated!
!
crypto pki token default removal timeout 0
!
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
!
interface Serial0/0/1
 no ip address
 shutdown
!
ip forward-protocol nd
```

```
no ip http server
no ip http secure-server
!
control-plane
!
mgcp profile default
line con 0
line aux 0
line vty 0 4
 login
 transport input all
!
scheduler allocate 20000 1000
end

Router#
```

To view router startup configuration (NVRAM)

Router# **show startup-config**

startup-config is not present

To navigate into Global Configuration Mode

Router # **configure terminal**
Router (config) #

Configure Hostname and Interface IPv6 address

To change the Host Name of Router

Router (config) # **hostname HYD-1**
HYD-1 (config) #

To configure IPv6 address on Ethernet Interface (LAN interface)

HYD-1 (config) # **interface Fastethernet 0/0**
HYD-1 (config-if) # **ipv6 address 2001:1111::1/64**
HYD-1 (config-if) # **no shutdown**
HYD-1 (config-if) # **exit**

Configure Connectivity Passwords

To configure telnet password

HYD-1 (config) # **line vty 0 4**
HYD-1 (config-line) # **password zoom**
HYD-1 (config-line) # **login**
HYD-1 (config-line) # **exit**

To configure console password

HYD-1 (config) # **line console 0**
HYD-1 (config-line) # **password ccna**
HYD-1 (config-line) # **login**
HYD-1 (config-line) # **exit**

To configure auxiliary password

HYD-1 (config) # **line aux 0**
HYD-1 (config-line) # **password cisco**
HYD-1 (config-line) # **login**
HYD-1 (config-line) # **exit**

Configure Privilege Mode / Enable Password

Configure privilege password

HYD-1 (config) # **enable password ccna**
HYD-1 (config) # **enable secret zoom**

Verify configuration in RAM and NVRAM

To View Router Current Configuration (RAM)

HYD-1 # **show running-config**

```
Current configuration : 1241 bytes
!
Last configuration change at 08:37:39 UTC Sat Jul 9 2016
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname HYD-1
!
boot-start-marker
boot-end-marker
!
!
enable secret 5 $1$DMgk$ITC7TUZVwFn5969wEB2mw.
enable password ccna
!
no aaa new-model
!
dot11 syslog
ip source-route
!
ip cef
```

```
!
multilink bundle-name authenticated
crypto pki token default removal timeout 0
!
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
 ip address ipv6 address 2001:1111::1/64
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
 clock rate 2000000
!
interface Serial0/0/1
 no ip address
 shutdown
 clock rate 2000000
!
ip forward-protocol nd
no ip http server
no ip http secure-server!
control-plane
!
mgcp profile default
!
line con 0
 password ccna
 login
line aux 0
 password cisco
 login
line vty 0 4
 password zoom
 login
 transport input all
!
scheduler allocate 20000 1000
end
```

To View Router Startup Configuration (NVRAM)

HYD-1 # **show startup-config**

startup-config is not present

Saving configuration to the router

To save configuration on router

HYD-1 # **copy running-config startup-config**

Destination filename [startup-config]?
Building configuration...

[OK]
HYD-1 #

To view router startup configuration (NVRAM)

HYD-1 # **show startup-config**

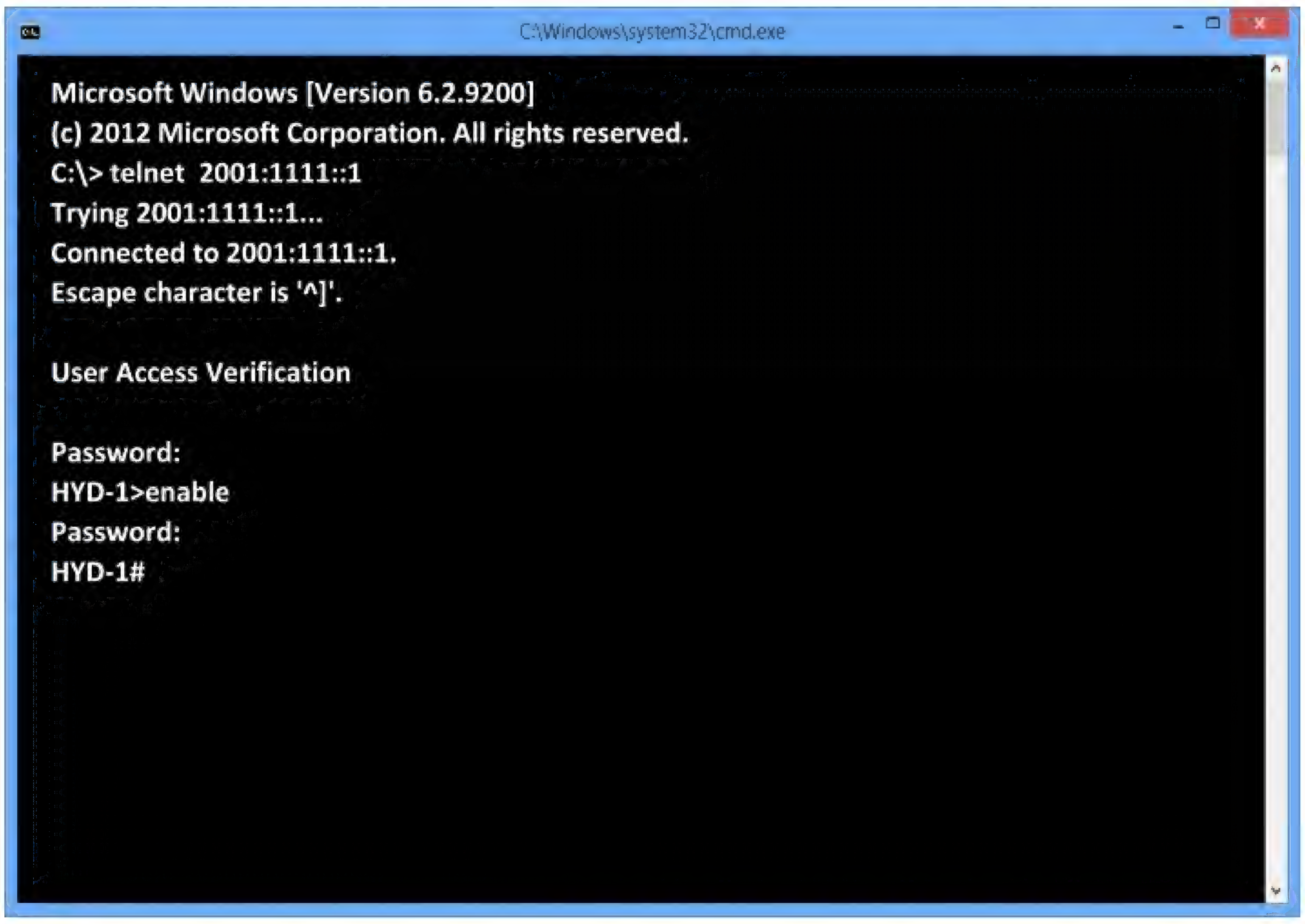
```
Current configuration : 1241 bytes
!
Last configuration change at 08:40:39 UTC Sat Jul 9 2016
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname HYD-1
!
boot-start-marker
boot-end-marker
!
!
enable secret 5 $1$DMgk$lTC7TUZVwFn5969wEB2mw.
enable password ccna
!
no aaa new-model
!
dot11 syslog
ip source-route
!
ip cef
!
no ipv6 cef
!
multilink bundle-name authenticated
crypto pki token default removal timeout 0
!
```

```
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
 ip address ipv6 address 2001:1111::1/64
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
 clock rate 2000000
!
interface Serial0/0/1
 no ip address
 shutdown
 clock rate 2000000
!
ip forward-protocol nd
no ip http server
no ip http secure-server!
control-plane
!
mgcp profile default!
!
line con 0
 password ccna
 login
line aux 0
 password cisco
 login
line vty 0 4
 password zoom
 login
 transport input all
!
scheduler allocate 20000 1000
end
```

Access the router via Telnet

- Accessing router via telnet by giving below command on a Windows or Linux computer.

  telnet 2001:1111::1



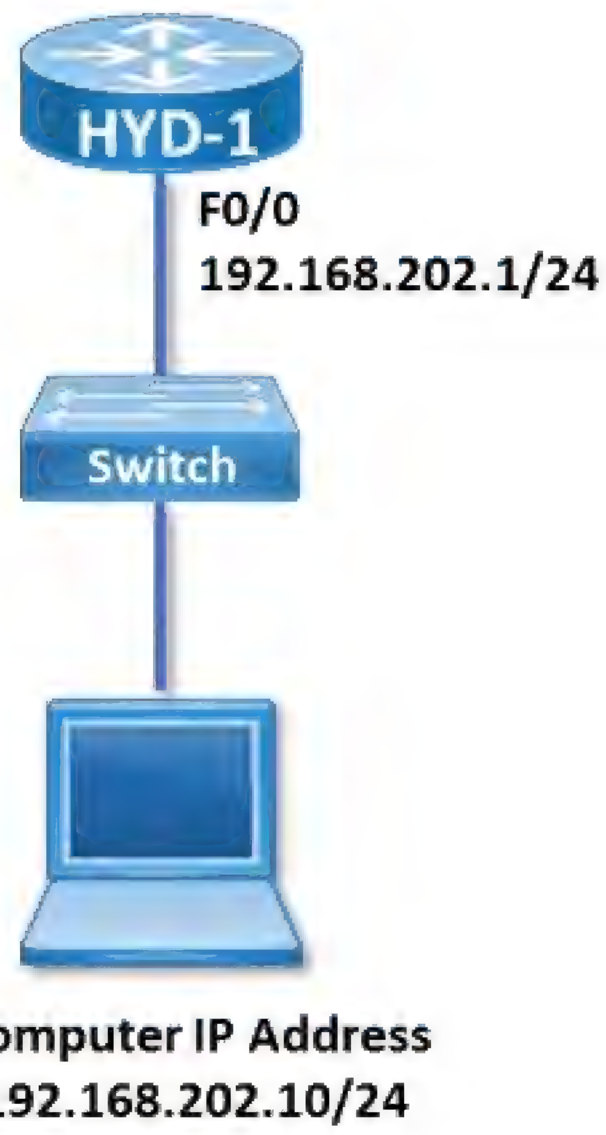
LAB 5 : BASIC ROUTER SECURITY

OBJECTIVE:

To enhance router security by encrypting all passwords, configure banners, exec-timeouts on router.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Pre-requisite: Initial configuration to be done on the router (LAB – 3)

TASKS:

- Access router via Telnet
- Encrypt all clear text passwords on the router.
- Configure Warning Banner
- Configure unattended (idle-timeout) session timeout for VTY access

Access router via Telnet

- Access router via telnet by giving below command on a Windows or Linux computer.

  telnet 192.168.202.1

Encrypt all clear text passwords on the router

Verify router's existing configuration

All password are in clear text except **enable secret password**

HYD-1 # **sh running-config**
Current configuration : 1241 bytes
!
Last configuration change at 08:37:39 UTC Sat Jul 9 2016
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname HYD-1
!
boot-start-marker
boot-end-marker
!
enable secret 5 1DMgk$lTC7TUZVwFn5969wEB2mw.
enable password ccna
!
no aaa new-model
!
dot11 syslog
ip source-route
!
ip cef

```
!
multilink bundle-name authenticated
crypto pki token default removal timeout 0
!
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
 ip address 192.168.202.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
!
interface Serial0/0/1
 no ip address
 shutdown
!
ip forward-protocol nd
no ip http server
no ip http secure-server!
control-plane
!
mgcp profile default
!
line con 0
 password ccna
 login
line aux 0
 password cisco
 login
line vty 0 4
 password zoom
 login
 transport input all
!
scheduler allocate 20000 1000
end

HYD-1 #
```

Encrypt all clear text passwords

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **service password-encryption**
HYD-1 (config) # **end**

Verification:

Now previously visible passwords are encrypted

HYD-1 # **sh running-config**

```
Building configuration...
Current configuration : 1241 bytes
!
Last configuration change at 08:37:39 UTC Sat Jul 9 2016
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname HYD-1
!
boot-start-marker
boot-end-marker
!
!
enable secret 5 $1$DMgk$ITC7TUZVwFn5969wEB2mw.
enable password 7 045802150C2E
!
no aaa new-model
!
dot11 syslog
ip source-route
!
ip cef
!
multilink bundle-name authenticated
crypto pki token default removal timeout 0
!
license udi pid CISCO2811 sn FHK1109F34X
!
redundancy
!
interface FastEthernet0/0
 ip address 192.168.202.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
```

```
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
!
interface Serial0/0/1
 no ip address
 shutdown
!
ip forward-protocol nd
no ip http server
no ip http secure-server!
control-plane
!
mgcp profile default
!
line con 0
 password 7 141411050D
 login
line aux 0
 password 7 030752180500
 login
line vty 0 4
 password 7 0109090B56
 login
 transport input all
!
scheduler allocate 20000 1000
end

HYD-1 #
```

Configure Warning Banner

Configure a warning message to display prior to login.

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **banner motd $**
Enter TEXT message. End with the character '**$**'.
==

UNAUTHORISED ACCESS STRICTLY PROHIBITED AND

PROSECUTED TO THE FULL EXTENT OF THE LAW

==$

Verification:

Now open a new telnet session from your computer to the router to verify the banner configured.

i.e. **telnet 192.168.202.1**

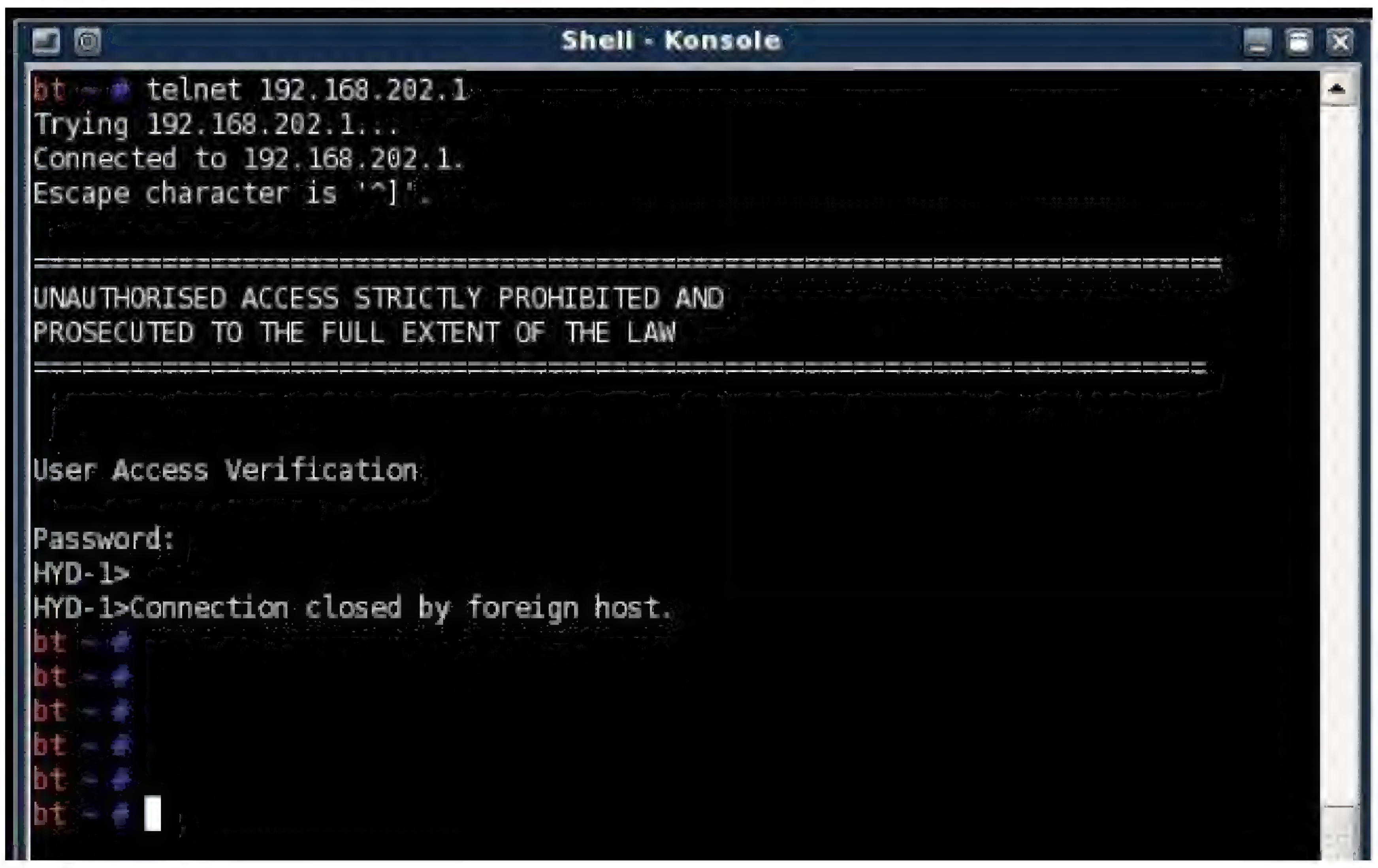
Configure unattended (idle-timeout) session timeout for VTY access

By default unattended session time-out is 10 minutes. We reducing the unattended session timeout to 1 minute 00 seconds.

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **line vty 0 4**
HYD-1 (config-line) # **exec-timeout 1 00**
HYD-1 (config-line) # **end**

Verification:

Now open a new telnet session from your computer to the router (get into privilege mode) and leave the session open without performing any action or modification for 1 minute. Session will be automatically disconnected after the session time-out has been reached.



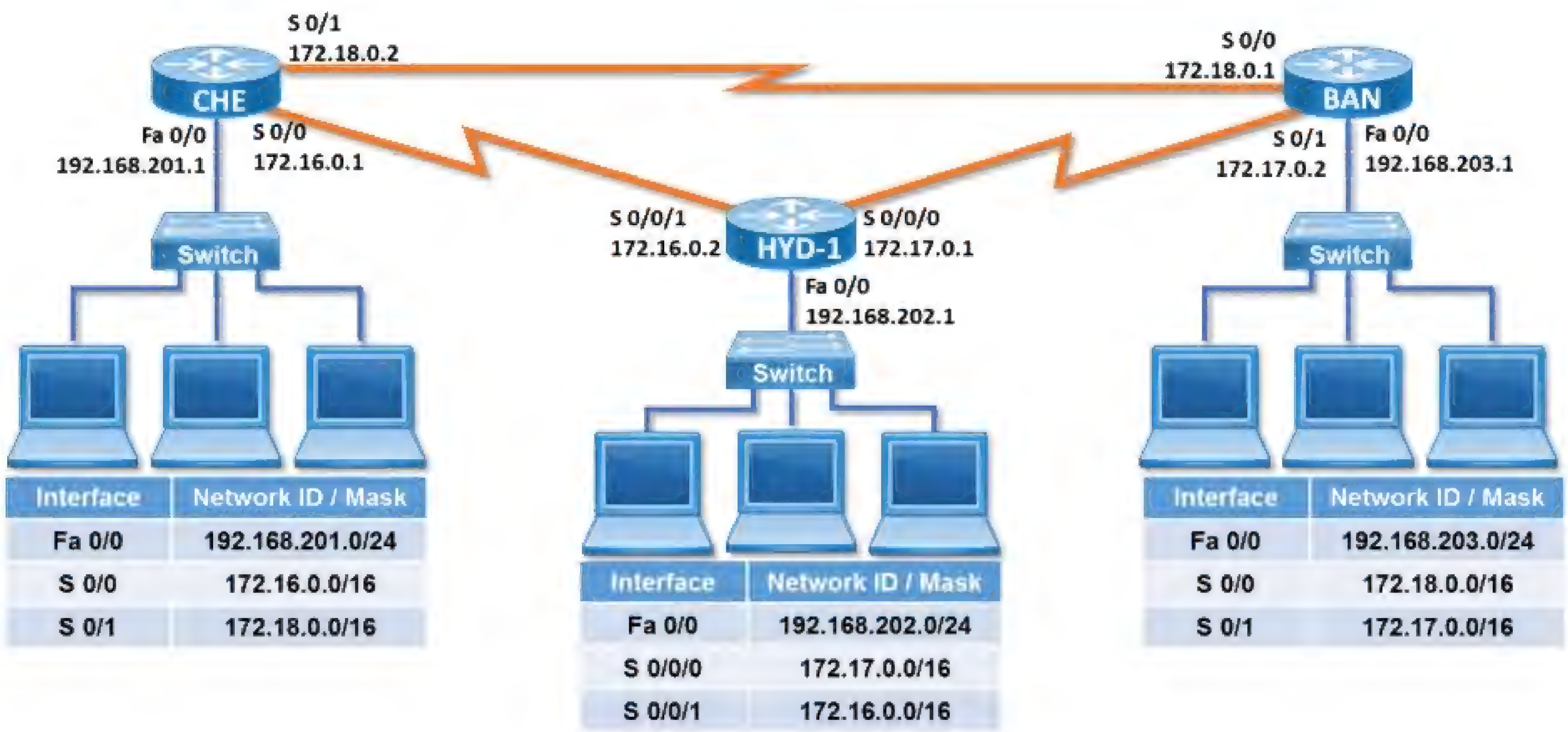
LAB 6: WAN CONFIGURATION – SERIAL INTERFACE (IPv4)

OBJECTIVE:

To configure and troubleshoot a Serial Interface.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



TASK:

- Identify Serial Interface as DCE or DTE
- Configure Serial Interface
- Verify Serial Interface Configuration
- Troubleshooting Serial Interface

Identify Serial Interface as DCE or DTE

Example - HYD-1

Identify DCE / DTE interface on HYD-1

HYD-1 # **show controllers serial 0/0/0**
Interface Serial0/0/0
Hardware is GT96K
DTE V.35
idb at 0x48C78680, driver data structure at 0x48C7FC80
wic_info 0x48C802AC
Physical Port 1, SCC Num 1
!
<output omitted>
!

HYD-1 # **show controllers serial 0/0/1**
Interface Serial0/0/1
Hardware is GT96K
DCE V.35, no clock
idb at 0x48C82750, driver data structure at 0x48C89F94
wic_info 0x48C8A5C0
Physical Port 0, SCC Num 0
!
<output omitted>
!

Verify Serial Interface existing status

HYD-1 # **show interface serial 0/0/0**
Serial0/0/0 is administratively down, line protocol is down
 Hardware is GT96K Serial
 MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
 reliability 255/255, txload 1/255, rxload 1/255
 Encapsulation HDLC, loopback not set
 Keepalive set (10 sec)
 !
 <output omitted>
 !

HYD-1 # **show interface serial 0/0/1**
Serial0/0/1 is administratively down, line protocol is down
 Hardware is GT96K Serial
 MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
 reliability 255/255, txload 1/255, rxload 1/255
 Encapsulation HDLC, loopback not set
 Keepalive set (10 sec)
 !
 <output omitted>
 !

Verify HYD-1's existing configuration

HYD-1 # **show running-config**
Building configuration...
Current configuration : 1210 bytes
hostname HYD-1
!
<output omitted>
!
interface FastEthernet0/0
ip address 192.168.202.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
no ip address
 shutdown
!
interface Serial0/0/1
 no ip address
 shutdown
!
<output omitted>
!
end

HYD-1 #

Repeat the above commands on CHE and BAN routers.

Configure Serial Interface

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config)# **interface serial 0/0**
CHE (config-if)# **ip address 172.16.0.1 255.255.0.0**
CHE (config-if)# **no shutdown**
CHE (config-if)# **clock rate 64000**
CHE (config-if)# **encapsulation hdlc**
CHE (config-if)# **exit**
CHE (config)#

CHE (config)# **interface serial 0/1**
CHE (config-if)# **ip address 172.18.0.2 255.255.0.0**
CHE (config-if)# **no shutdown**
CHE (config-if)# **encapsulation hdlc**
CHE (config-if)# **exit**
CHE (config)# **exit**

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config)# **interface serial 0/0/0**
HYD-1 (config-if)# **ip address 172.17.0.1 255.255.0.0**
HYD-1 (config-if)# **no shutdown**
HYD-1 (config-if)# **clock rate 64000**
HYD-1 (config-if)# **encapsulation hdlc**
HYD-1 (config-if)# **exit**
HYD-1 (config)#

HYD-1 (config)# **interface serial 0/0/1**
HYD-1 (config-if)# **ip address 172.16.0.2 255.255.0.0**
HYD-1 (config-if)# **no shutdown**
HYD-1 (config-if)# **encapsulation hdlc**
HYD-1 (config-if)# **exit**
HYD-1 (config)# **exit**

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config)# **interface serial 0/0**
BAN (config-if)# **ip address 172.18.0.1 255.255.0.0**
BAN (config-if)# **no shutdown**
BAN (config-if)# **clock rate 64000**
BAN (config-if)# **encapsulation hdlc**
BAN (config-if)# **exit**
BAN (config)#

BAN (config)# **interface serial 0/1**
BAN (config-if)# **ip address 172.17.0.2 255.255.0.0**
BAN (config-if)# **no shutdown**
BAN (config-if)# **encapsulation hdlc**
BAN (config-if)# **exit**
BAN (config)# **exit**

Verify Serial Interface Configuration

CHE – Verification

CHE # **show interface serial 0/0**

```
Serial0/0 is up, line protocol is up
  Hardware is PowerQUICC Serial
Internet address is 172.16.0.1/16
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set
  Keepalive set (10 sec)
  !
<output omitted>
  !
```

CHE# **show interface serial 0/1**

```
Serial0/1 is up, line protocol is up
  Hardware is PowerQUICC Serial
Internet address is 172.18.0.2/16
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set
  Keepalive set (10 sec)
  !
<output omitted>
  !
```

HYD-1 – Verification:

HYD-1 # **show interface serial 0/0/0**

```
Serial0/0/0 is up, line protocol is up
  Hardware is GT96K Serial
Internet address is 172.17.0.1/16
  MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set
  Keepalive set (10 sec)
  !
<output omitted>
```

HYD-1 # **show interface serial 0/0/1**

```
Serial0/0/1 is up, line protocol is up
  Hardware is GT96K Serial
Internet address is 172.16.0.2/16
  MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set
  Keepalive set (10 sec)
  !
<output omitted>
```

BAN – Verification:

BAN # **show interface serial 0/0**
Serial0/0 is up, line protocol is up
 Hardware is PowerQUICC Serial
Internet address is 172.18.0.1/16
 MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
   reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set
 Keepalive set (10 sec)
 !
<output omitted>
 !

BAN # **show interface serial 0/1**
Serial0/1 is up, line protocol is up
 Hardware is PowerQUICC Serial
Internet address is 172.17.0.2/16
 MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
   reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set
 Keepalive set (10 sec)
 !
<output omitted>
 !

Troubleshooting Serial Interface

From the output, the first line indicates the status of the Serial interface. There are 4 possible states:

1. **Serial 0/0 is up , line protocol is up**

   Layer 1 and Layer 2 Connectivity and configuration is fine

2. **Serial 0/0 is administratively down, line protocol is down**

   'No Shutdown' has to be given on the local Router's Serial interface

3. **Serial 0/0 is up, line protocol is down**

   Encapsulation mismatch or clock rate has not been given on the DCE interface or Lease Line problem

4. **Serial 0/0 is down, line protocol is down**

   Problem with the v.35 cable, CSU/DSU or 'no shutdown' has not been given on the remote Router

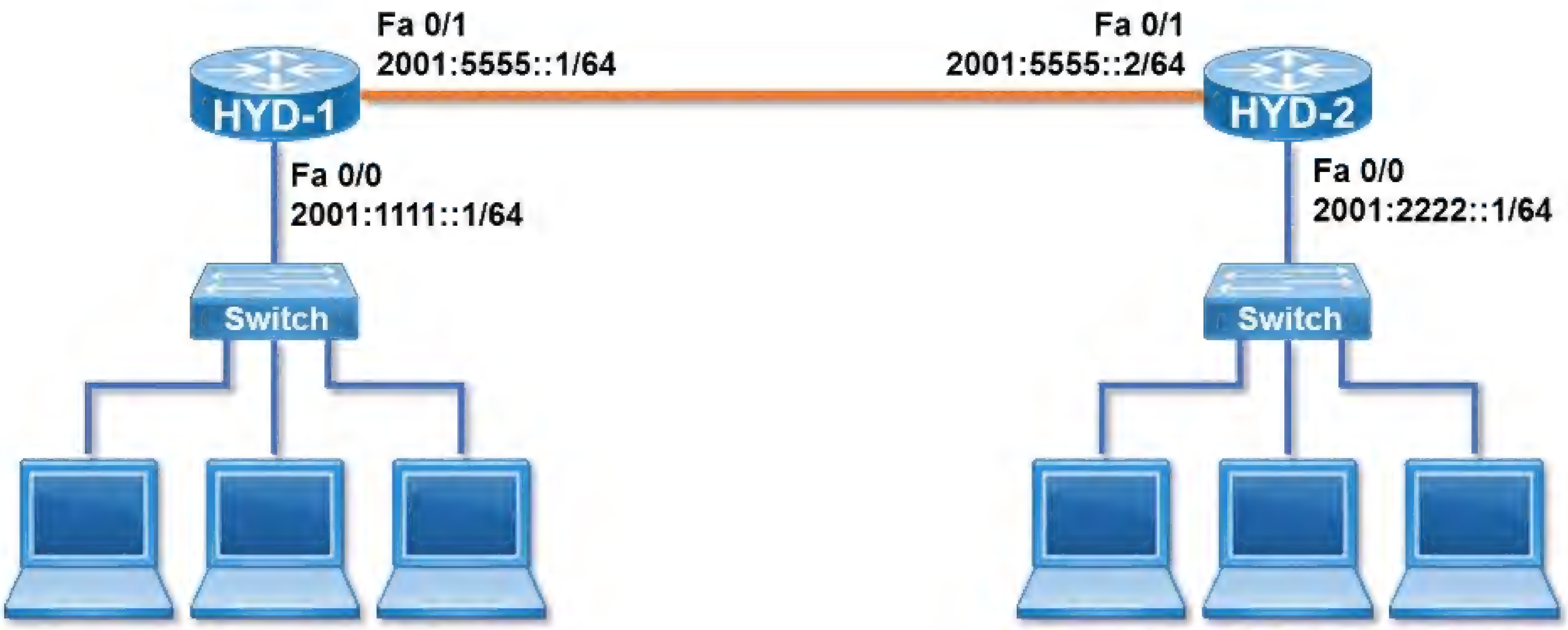
LAB 7: WAN CONFIGURATION – ETHERNET INTERFACE (IPv6)

OBJECTIVE:

To configure and troubleshoot an Ethernet Interface.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	2001:1111::/64
Fa 0/1	2001:5555::/64

Interface	Network ID / Mask
Fa 0/0	2001:2222::/64
Fa 0/1	2001:5555::/64

TASK:

- Verify Ethernet Interface existing status
- Configure Ethernet Interface with IPv6 address
- Verify IPv6 Address Configuration on Ethernet Interface
- Troubleshooting Ethernet Interface

Verify Ethernet Interface existing status

HYD-1 # **show interface fastethernet 0/1**

```
FastEthernet0/ is administratively down, line protocol is down
 Hardware is MV96340 Ethernet, address is 0017.9460.c209 (bia 0017.9460.c209)
 MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
   reliability 255/255, txload 1/255, rxload 1/255
 Encapsulation ARPA, loopback not set
 Keepalive set (10 sec)
 Full-duplex, 100Mb/s, 100BaseTX/FX
 !
 <output omitted>
 !
```

Verify HYD-1's existing configuration

HYD-1 # **show running-config**

```
Building configuration...
Current configuration : 1210 bytes
hostname HYD-1
!
<output omitted>
!
interface FastEthernet0/0
ip address 192.168.202.1 255.255.255.0
ip address ipv6 address 2001:1111::1/64
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 ip address 172.17.0.1 255.255.0.0
!
interface Serial0/0/1
 ip address 172.16.0.2 255.255.0.0
!
<output omitted>
!
end

HYD-1 #
```

Repeat the above commands on HYD-2 router.

Configure Ethernet Interface with IPv6 address

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config)# **interface fastethernet 0/1**
HYD-1 (config-if)# **ipv6 address 2001:5555::1/64**
HYD-1 (config-if)# **no shutdown**
HYD-1 (config-if)# **exit**
HYD-1 (config)#

HYD-2 – Configuration

HYD-2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-2 (config)# **interface fastethernet 0/1**
HYD-2 (config-if)# **ipv6 address 2001:5555::2/64**
HYD-2 (config-if)# **no shutdown**
HYD-2 (config-if)# **exit**
HYD-2 (config)#

Verify IPv6 Address Configuration on Ethernet Interface

HYD-1 – Verification

HYD-1 # **show ipv6 interface fastethernet 0/1**

```
FastEthernet0/1 is up, line protocol is up
 IPv6 is enabled, link-local address is FE80::21B:D4FF:FE3D:B279
 Global unicast address(es):
  2001:5555::1, subnet is 2001:5555::/64
 Joined group address(es):
  FF02::1
  FF02::2
  FF02::1:FF00:1
  FF02::1:FF3D:B279
 MTU is 1500 bytes
 ICMP error messages limited to one every 100 milliseconds
 ICMP redirects are enabled
 ND DAD is enabled, number of DAD attempts: 1
 ND reachable time is 30000 milliseconds
 Default router is FE80::217:94FF:FE60:C209 on FastEthernet0/1
HYD-1#
```

HYD-2 – Verification

```
HYD-2 # show ipv6 interface fastethernet 0/1
FastEthernet0/1 is up, line protocol is up
 IPv6 is enabled, link-local address is FE80::217:94FF:FE60:C209
 Global unicast address(es):
  2001:5555::2, subnet is 2001:5555::/64
 Joined group address(es):
  FF02::1
  FF02::2
  FF02::1:FF00:2
  FF02::1:FF3D:B279
 MTU is 1500 bytes
 ICMP error messages limited to one every 100 milliseconds
 ICMP redirects are enabled
 ND DAD is enabled, number of DAD attempts: 1
 ND reachable time is 30000 milliseconds
 Default router is FE80::21B:D4FF:FE3D:B279 on FastEthernet0/1
HYD-2#
```

Troubleshooting Ethernet Interface

From the output, the first line indicates the status of the Etherent interface. There are 4 possible states:

1. **Fastethernet 0/0 is up , line protocol is up**

   Layer 1 and Layer 2 Connectivity and configuration is fine

2. **Fastethernet 0/0 is administratively down, line protocol is down**

   'No Shutdown' has to be given on the local etherent interface

3. **Fastethernet 0/0 is up, line protocol is down**

   Speed & Duplex Mismatch or 'No Shutdown' has not been given on the remote device ethernet interface.

4. **Fastethernet 0/0 is down, line protocol is down**

   Layer 1 problem - No device attached or faulty cable.

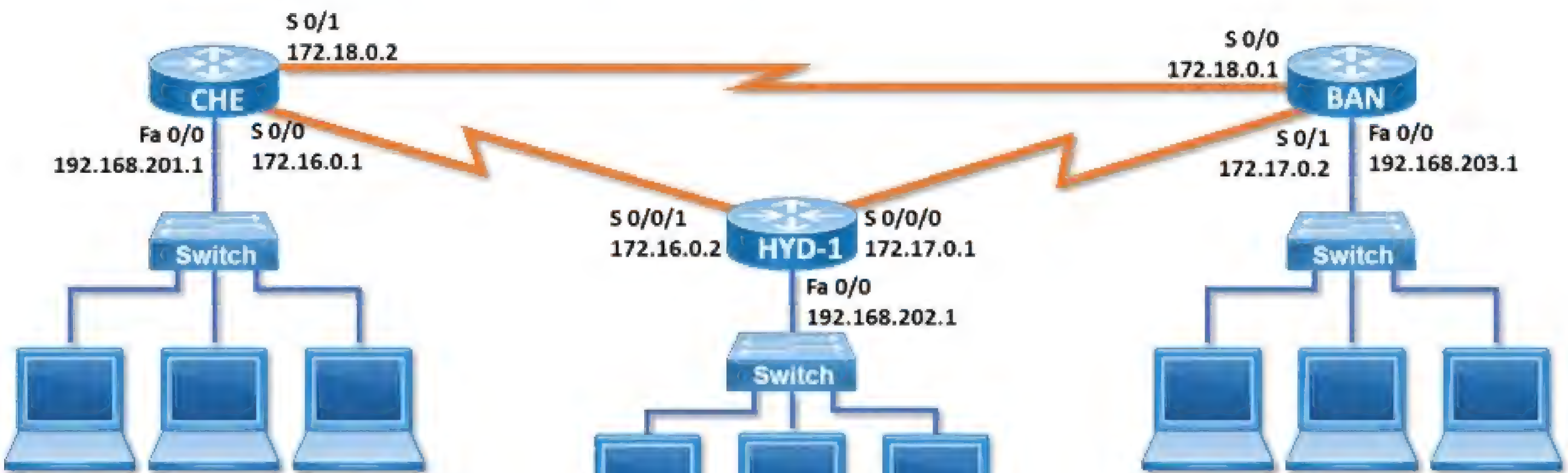
LAB 8: STATIC ROUTING ON IPv4 NETWORK

OBJECTIVE:

To configure Static Routing on IPv4 Network for enabling communication between different networks connected to different routers. To set up static routes on CHE, HYD-1, BAN to connect to each other's local networks.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	172.16.0.0/16
S 0/1	172.18.0.0/16

Interface	Network ID / Mask
Fa 0/0	192.168.202.0/24
S 0/0/0	172.17.0.0/16
S 0/0/1	172.16.0.0/16

Interface	Network ID / Mask
Fa 0/0	192.168.203.0/24
S 0/0	172.18.0.0/16
S 0/1	172.17.0.0/16

Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)

TASK:

- Enabling IPv4 Routing
- Verify IPv4 Routing Table
- Configure Static Routing on IPv4 Network
- Verify Static Routing on IPv4 Network
- Verify communication between the IPv4 networks.

Enabling IPv4 Routing

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip routing**
CHE (config) #

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip routing**
HYD-1 (config) #

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # **ip routing**
BAN (config) #

Note : Once routing is enabled the directly connected networks are automatically added into the routing information table. **"C"** represents directly connected networks. The IPv4 Network is learnt through the local Interface of the router.

Verify IPv4 Routing Table

CHE – Verification:

CHE # **show ip route**

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    172.16.0.0/16 is directly connected, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/1
C    192.168.201.0/24 is directly connected, FastEthernet0/0
CHE #
```

HYD-1 – Verification:

```
HYD-1 # show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.202.0/24 is directly connected, FastEthernet0/0
L        10.0.0.1/32 is directly connected, FastEthernet0/0
      172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.16.0.0/16 is directly connected, Serial0/0/1
L        172.16.0.2/32 is directly connected, Serial0/0/1
      172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.17.0.0/16 is directly connected, Serial0/0/0
L        172.17.0.1/32 is directly connected, Serial0/0/0
HYD-1 #
```

BAN – Verification:

```
BAN # show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    172.17.0.0/16 is directly connected, Serial0/1
C    172.18.0.0/16 is directly connected, Serial0/0
C    192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #
```

Configure Static Routing on IPv4 Network

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip route 192.168.202.0 255.255.255.0 172.16.0.2**
CHE (config) # **ip route 192.168.203.0 255.255.255.0 172.18.0.1**
CHE (config) # **exit**
CHE (config) #

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip route 192.168.201.0 255.255.255.0 172.16.0.1**
HYD-1 (config) # **ip route 192.168.203.0 255.255.255.0 172.17.0.2**
HYD-1 (config) # **exit**
HYD-1 (config) #

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # **ip route 192.168.202.0 255.255.255.0 172.17.0.1**
BAN (config) # **ip route 192.168.201.0 255.255.255.0 172.18.0.2**
BAN (config) # **exit**
BAN (config) #

Verify Static Routing on IPv4 Network

Once Static routing is enabled, the IPv4 Networks defined with the **Static routing command** are added into the routing information table. **"S"** represents **Static route.**

CHE – Verification:

CHE # **show ip route**

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
    D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
    E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
    i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
    * - candidate default, U - per-user static route, o - ODR
    P - periodic downloaded static route

Gateway of last resort is not set

C    172.16.0.0/16 is directly connected, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/1
S    192.168.202.0/24 [1/0] via 172.16.0.2
```

```
C    192.168.201.0/24 is directly connected, FastEthernet0/0
S    192.168.203.0/24 [1/0] via 172.18.0.1
CHE #
```

HYD-1 – Verification:

```
HYD-1 # show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

 192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.202.0/24 is directly connected, FastEthernet0/0
L       192.168.202.1/32 is directly connected, FastEthernet0/0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/16 is directly connected, Serial0/0/1
L       172.16.0.2/32 is directly connected, Serial0/0/1
     172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.17.0.0/16 is directly connected, Serial0/0/0
L       172.17.0.1/32 is directly connected, Serial0/0/0
S     192.168.201.0/24 [1/0] via 172.16.0.1
S     192.168.203.0/24 [1/0] via 172.17.0.2
HYD-1 #
```

BAN – Verification:

```
BAN # show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    172.17.0.0/16 is directly connected, Serial0/1
C    172.18.0.0/16 is directly connected, Serial0/0
S    192.168.202.0/24 [1/0] via 172.17.0.1
S    192.168.201.0/24 [1/0] via 172.18.0.2
C    192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #
```

Verify communication between the IPv4 networks

Verification from a Computer in HYD-1 Network

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

Repeat the above ping verification from a computer in CHE and BAN Network.

From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)

```
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)

```
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

Repeat the above trace communication path from a computer in CHE and BAN Network.

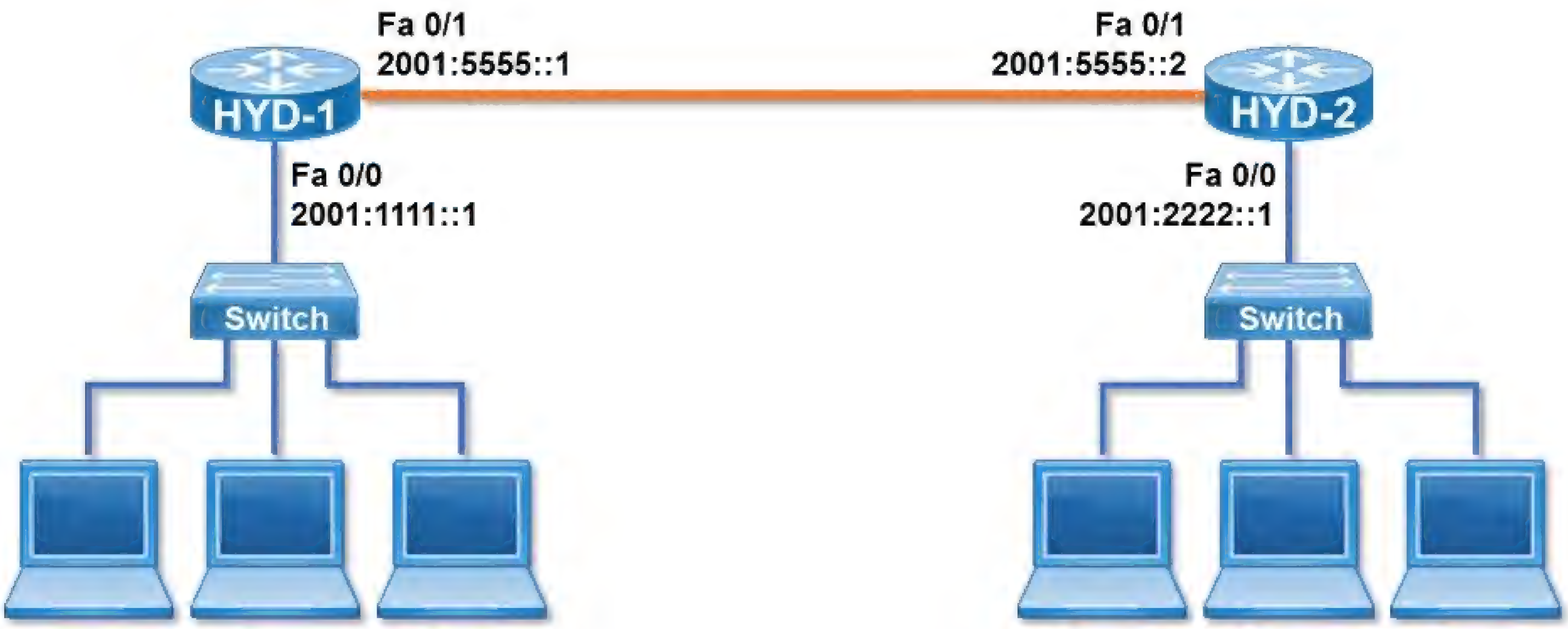
LAB 9: STATIC ROUTING ON IPv6 NETWORK

OBJECTIVE:

To configure Static Routing on IPv6 Network for enabling communication between different networks connected to different routers. To set up static routes on HYD-1 and HYD-2 to connect to each other's local networks.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	2001:1111::/64
Fa 0/1	2001:5555::/64

Interface	Network ID / Mask
Fa 0/0	2001:2222::/64
Fa 0/1	2001:5555::/64

Pre-requisite: WAN Interface configuration to be done on the router (LAB – 7)

TASK:

- Enabling IPv6 Routing
- Verify IPv6 Routing Table
- Configure Static Routing on IPv6 Network
- Verify Static Routing on IPv6 Network
- Verify communication between the IPv6 networks.

Enabling IPv6 Routing

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ipv6 unicast-routing**
HYD-1 (config) #

HYD-2 – Configuration

HYD-2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-2 (config) # **ipv6 unicast-routing**
HYD-2 (config) #

Note : Once routing is enabled the directly connected networks are automatically added into the routing information table. **"C"**represents directly connected networks. The IPv6 Network is learnt through the local Interface of the router.

Verify IPv6 Routing Table

HYD-1 – Verification:

```
HYD-1# show ipv6 route
IPv6 Routing Table - default - 5 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
       l - LISP
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

C  2001:1111::/64 [0/0]
   via FastEthernet0/0, directly connected
L  2001:1111::1/128 [0/0]
   via FastEthernet0/0, receive
C  2001:5555::/64 [0/0]
   via FastEthernet0/1, directly connected
L  2001:5555::1/128 [0/0]
   via FastEthernet0/1, receive
L  FF00::/8 [0/0]
   via Null0, receive
HYD-1#
```

HYD-2 – Verification:

HYD-1 # **show ipv6 route**
IPv6 Routing Table - default - 5 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
    B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
    D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
    l - LISP
    O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
    ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
C 2001:2222::/64 [0/0]
   via FastEthernet0/0, directly connected
L 2001:2222::1/128 [0/0]
   via FastEthernet0/0, receive
C 2001:5555::/64 [0/0]
   via FastEthernet0/1, directly connected
L 2001:5555::2/128 [0/0]
   via FastEthernet0/1, receive
L FF00::/8 [0/0]
   via Null0, receive
HYD-2#

Configure Static Routing on IPv6 Network

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ipv6 route 2001:2222::/64 2001:5555::2**
HYD-1 (config) # **exit**
HYD-1 (config) #

HYD-2 – Configuration

HYD-2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-2 (config) # **ipv6 route 2001:1111::/64 2001:5555::1**
HYD-2 (config) # **exit**
HYD-2 (config) #

Verify Static Routing on IPv6 Network

Once Static routing is enabled, the IPv6 Networks defined with the **Static routing command** are added into the routing information table. **"S"** represents **Static route.**

HYD-1 – Verification:

```
HYD-1 # show ip route
IPv6 Routing Table - default - 6 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
    B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
    D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
    O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
    ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
C  2001:1111::/64 [0/0]
   via FastEthernet0/0, directly connected
L  2001:1111::1/128 [0/0]
   via FastEthernet0/0, receive
S  2001:2222::/64 [1/0]
   via 2001:5555::2
C  2001:5555::/64 [0/0]
   via FastEthernet0/1, directly connected
L  2001:5555::1/128 [0/0]
   via FastEthernet0/1, receive
L  FF00::/8 [0/0]
   via Null0, receive
HYD-1#
```

HYD-2 – Verification:

```
HYD-2 # show ipv6 route
IPv6 Routing Table - default - 6 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
    B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
    D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
    O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
    ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
S  2001:1111::/64 [1/0]
      via 2001:5555::1
C  2001:2222::/64 [0/0]
   via FastEthernet0/0, directly connected
L  2001:2222::1/128 [0/0]
   via FastEthernet0/0, receive
C  2001:5555::/64 [0/0]
   via FastEthernet0/1, directly connected
L  2001:5555::2/128 [0/0]
   via FastEthernet0/1, receive
L  FF00::/8 [0/0]
   via Null0, receive
HYD-2#
```

Verify communication between the IPv6 networks

Verification from a Computer in HYD-1 Network

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms

Verification from a Computer in HYD-2 Network

ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)

PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=62 time=0.336 ms

From a Computer in HYD-1 Network trace communication path to a Computer in HYD-2 Network

`tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)`

```
traceroute to 2001:2222::10 (2001:2222::10), 30 hops max, 80 byte packets
 1  2001:1111::1 (2001:1111::1)  2.825 ms  3.239 ms  3.665 ms
 2  2001:5555::2 (2001:5555::2)  9.086 ms  9.393 ms  9.642 ms
 3  2001:2222::10 (2001:2222::10)  9.781 ms  10.474 ms  10.720 ms
```

From a Computer in HYD-2 Network trace communication path to a Computer in HYD-1 Network

`tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)`

```
traceroute to 2001:1111::10 (2001:1111::10), 30 hops max, 80 byte packets
 1  2001:2222::1 (2001:2222::1)  1.071 ms  1.152 ms  1.238 ms
 2  2001:5555::1 (2001:5555::1)  4.303 ms  4.930 ms  5.419 ms
 3  2001:1111::10 (2001:1111::10)  10.832 ms  11.444 ms  11.541 ms
```

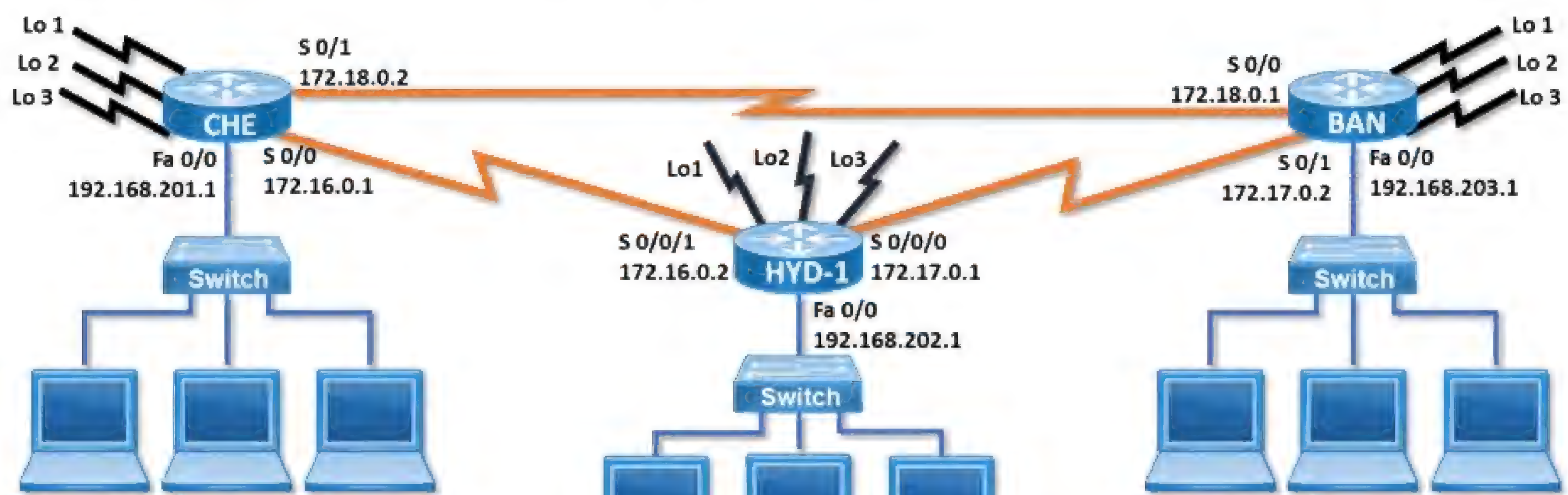
LAB 10: RIP ON IPv4 NETWORK

OBJECTIVE:

To configure RIP routing for communicating between different IPv4 networks on different routers.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	172.16.0.0/16
S 0/1	172.18.0.0/16

Interface	IP Address / Mask
Lo1	16.1.1.1/24
Lo2	16.1.2.1/24
Lo3	16.1.3.1/24

Interface	Network ID / Mask
Fa 0/0	192.168.202.0/24
S 0/0/0	172.17.0.0/16
S 0/0/1	172.16.0.0/16

Interface	IP Address / Mask
Lo1	17.1.1.1/24
Lo2	17.1.2.1/24
Lo3	17.1.3.1/24

Interface	Network ID / Mask
Fa 0/0	192.168.203.0/24
S 0/0	172.18.0.0/16
S 0/1	172.17.0.0/16

Interface	IP Address / Mask
Lo1	18.1.1.1/24
Lo2	18.1.2.1/24
Lo3	18.1.3.1/24

Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)

TASK:

- Configure Loopback Interface
- Verify Loopback Interface
- Configure RIP Routing on IPv4 network
- Verify RIP Routing on IPv4 network
- Verify Communication between the IPv4 networks
- Verify RIP protocol default settings
- Verify RIP Update Packets
- Changing RIP Timers
- Enabling Passive Interface on RIP
- Verify RIP Database
- Disabling RIP Auto Summary

Configure Loopback Interface

Configure Loopback interface according to Lab Topology

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config)# **interface Lo 1**
CHE (config-if)# **ip address 16.1.1.1 255.255.255.0**
CHE (config)# **interface Lo 2**
CHE (config-if)# **ip address 16.1.2.1 255.255.255.0**
CHE (config)# **interface Lo 3**
CHE (config-if)# **ip address 16.1.3.1 255.255.255.0**
CHE (config-if)# **exit**

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config)# **interface Lo 1**
HYD-1 (config-if)# **ip address 17.1.1.1 255.255.255.0**
HYD-1 (config)# **interface Lo 2**
HYD-1 (config-if)# **ip address 17.1.2.1 255.255.255.0**
HYD-1 (config)# **interface Lo 3**
HYD-1 (config-if)# **ip address 17.1.3.1 255.255.255.0**
HYD-1 (config-if)# **exit**

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config)# **interface Lo 1**
BAN (config-if)# **ip address 18.1.1.1 255.255.255.0**
BAN (config)# **interface Lo 2**
BAN (config-if)# **ip address 18.1.2.1 255.255.255.0**
BAN (config)# **interface Lo 3**
BAN (config-if)# **ip address 18.1.3.1 255.255.255.0**
BAN (config-if)# **exit**

Verify Loopback Interface

CHE – Verification:

CHE # **show ip interface brief**

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	192.168.201.1	YES	NVRAM	up	up
Serial0/0	172.16.0.1	YES	NVRAM	up	up
Serial0/1	172.18.0.2	YES	NVRAM	up	up
Loopback1	16.1.1.1	YES	manual	up	up
Loopback2	16.1.2.1	YES	manual	up	up
Loopback3	16.1.3.1	YES	manual	up	up

HYD-1 – Verification:

HYD-1# **show ip interface brief**

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	192.168.202.1	YES	NVRAM	up	up
FastEthernet0/1	unassigned	YES	NVRAM	administratively down	down
Serial0/0/0	172.17.0.1	YES	manual	up	up
Serial0/0/1	172.16.0.2	YES	manual	up	up
Loopback1	17.1.1.1	YES	manual	up	up
Loopback2	17.1.2.1	YES	manual	up	up
Loopback3	17.1.3.1	YES	manual	up	up

BAN – Verification:

HYD-1# **show ip interface brief**

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	192.168.203.1	YES	NVRAM	up	up
Serial0/0	172.18.0.1	YES	NVRAM	up	up
FastEthernet0/1	unassigned	YES	NVRAM	administratively down	down
Serial0/1	172.17.0.2	YES	NVRAM	up	up
Loopback1	18.1.1.1	YES	manual	up	up
Loopback2	18.1.2.1	YES	manual	up	up
Loopback3	18.1.3.1	YES	manual	up	up

Configure RIP Routing on IPv4 network

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip routing**
CHE (config) # **router rip**
CHE (config-router) # **version 2**
CHE (config-router) # **network 192.168.201.0**
CHE (config-router) # **network 172.16.0.0**
CHE (config-router) # **network 172.18.0.0**
CHE (config-router) # **network 16.0.0.0**
CHE (config-router) # **end**
CHE #

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip routing**
HYD-1 (config) # **router rip**
HYD-1 (config-router) # **version 2**
HYD-1 (config-router) # **network 192.168.202.0**
HYD-1 (config-router) # **network 172.16.0.0**
HYD-1 (config-router) # **network 172.17.0.0**
HYD-1 (config-router) # **network 17.0.0.0**
HYD-1 (config-router) # **end**
HYD-1 #

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # **ip routing**
BAN (config) # **router rip**
BAN (config-router) # **version 2**
BAN (config-router) # **network 192.168.203.0**
BAN (config-router) # **network 172.17.0.0**
BAN (config-router) # **network 172.18.0.0**
BAN (config-router) # **network 18.0.0.0**
BAN (config-router) # **end**
BAN #

Verify RIP Routing on IPv4 network

Once RIP routing is enabled, IPv4 Networks learnt via **RIP** are added into the routing table. **"R"** represents **RIP route.**

CHE – Verification:

```
CHE # show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

R    17.0.0.0/8 [120/1] via 172.16.0.2, 00:00:03, Serial0/0
     16.0.0.0/24 is subnetted, 3 subnets
C       16.1.1.0 is directly connected, Loopback1
C       16.1.3.0 is directly connected, Loopback3
C       16.1.2.0 is directly connected, Loopback2
R    18.0.0.0/8 [120/1] via 172.18.0.1, 00:00:24, Serial0/1
R    172.17.0.0/16 [120/1] via 172.16.0.2, 00:00:03, Serial0/0
                   [120/1] via 172.18.0.1, 00:00:24, Serial0/1
C    172.16.0.0/16 is directly connected, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/1
C    192.168.201.0/24 is directly connected, FastEthernet0/0
R    192.168.202.0/24 [120/1] via 172.16.0.2, 00:00:03, Serial0/0
R    192.168.203.0/24 [120/1] via 172.18.0.1, 00:00:24, Serial0/1
CHE #
```

HYD-1 – Verification:

```
HYD-1 # show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

R    16.0.0.0/8 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
     17.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       17.1.1.0/24 is directly connected, Loopback1
L       17.1.1.1/32 is directly connected, Loopback1
C       17.1.2.0/24 is directly connected, Loopback2
```

```
L       17.1.2.1/32 is directly connected, Loopback2
C       17.1.3.0/24 is directly connected, Loopback3
L       17.1.3.1/32 is directly connected, Loopback3
R    18.0.0.0/8 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/16 is directly connected, Serial0/0/1
L       172.16.0.2/32 is directly connected, Serial0/0/1
     172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.17.0.0/16 is directly connected, Serial0/0/0
L       172.17.0.1/32 is directly connected, Serial0/0/0
R    172.18.0.0/16 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
                   [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R    192.168.201.0/24 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
     192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.202.0/24 is directly connected, FastEthernet0/0
L       192.168.202.1/32 is directly connected, FastEthernet0/0
R    192.168.203.0/24 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
HYD-1 #
```

<u>BAN – Verification</u>:

BAN # **show ip route**

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

R    17.0.0.0/8 [120/1] via 172.17.0.1, 00:00:07, Serial0/1
R    16.0.0.0/8 [120/1] via 172.18.0.2, 00:00:11, Serial0/0
     18.0.0.0/24 is subnetted, 3 subnets
C       18.1.3.0 is directly connected, Loopback3
C       18.1.2.0 is directly connected, Loopback2
C       18.1.1.0 is directly connected, Loopback1
C    172.17.0.0/16 is directly connected, Serial0/1
R    172.16.0.0/16 [120/1] via 172.17.0.1, 00:00:07, Serial0/1
                   [120/1] via 172.18.0.2, 00:00:11, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/0
R    192.168.201.0/24 [120/1] via 172.18.0.2, 00:00:11, Serial0/0
R    192.168.202.0/24 [120/1] via 172.17.0.1, 00:00:07, Serial0/1
C    192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #
```

Verify communication between the IPv4 networks

Verification from a Computer in HYD-1 Network

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

Repeat the above ping verification from a computer in CHE and BAN Network.

From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

Repeat the above trace communication path from a computer in CHE and BAN Network.

Verify RIP protocol default settings

Example - HYD-1

HYD-1 # **show ip protocols**
*** IP Routing is NSF aware ***

```
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 26 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface          Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0     2     2
    Serial0/0/0         2     2
    Serial0/0/1         2     2
    Loopback1           2     2
    Loopback2           2     2
    Loopback3           2     2
  Automatic network summarization is in effect
  Maximum path: 4
  Routing for Networks:
    17.0.0.0
    172.16.0.0
    172.17.0.0
    192.168.202.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    172.16.0.1           120      00:00:01
    172.17.0.2           120      00:00:23
  Distance: (default is 120)
HYD-1 #
```

Verify RIP Update Packets

Verify default behaviour of RIP Update packets by enabling debug commands

Example - HYD-1

HYD-1 # **terminal monitor**
HYD-1 # **debug ip rip**

```
RIP protocol debugging is on
RIP: received v2 update from 172.16.0.1 on Serial0/0/1
172.18.0.0/16 in 1 hops
192.168.201.0/24 in 1 hops
192.168.203.0/24 in 2 hops
RIP: sending v2 update to 224.0.0.9 via FastEthernet0/0 (192.168.202.1)
```

RIP: build update entries
network 172.16.0.0/16 metric 1
network 172.17.0.0/16 metric 1
network 172.18.0.0./16 metric 2
network 192.168.201.0/24 metric 2
network 192.168.203.0/24 metric 2
RIP: sending v2 update to 224.0.0.9 via Serial0/0/1 (172.16.0.2)
RIP: build update entries
network 192.168.202.0/24 metric 1
network 172.17.0.0/16 metric 1
network 192.168.203.0/24 metric 2
RIP: sending v2 update to 224.0.0.9 via Serial0/0/0 (172.17.0.1)
RIP: build update entries
network 192.168.202.0/24 metric 1
network 172.16.0.0/16 metric 1
network 192.168.201.0/24 metric 2

HYD-1 # **undebug all**
HYD-1 # **terminal no monitor**

Changing RIP Timers

Changing deafault RIP timers i.e. Update, Invalid, Hold and Flush Timers.

Example - HYD-1

HYD-1 (config) # **router rip**
HYD-1 (config-router) # **timers basic 15 90 90 120**
HYD-1 (config-router) # **exit**
HYD-1 (config) # exit

HYD-1 – Verification :

HYD-1 # **show ip protocols**
*** IP Routing is NSF aware ***

```
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 15 seconds, next due in 13 seconds
  Invalid after 90 seconds, hold down 90, flushed after 120
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface          Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0    2     2
    Serial0/0/0        2     2
    Serial0/0/1        2     2
    Loopback1          2     2
    Loopback2          2     2
    Loopback3          2     2
```

```
  Automatic network summarization is in effect
  Maximum path: 4
  Routing for Networks:
    17.0.0.0
    172.16.0.0
    172.17.0.0
    192.168.202.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    172.16.0.1         120      00:00:01
    172.17.0.2         120      00:00:23
  Distance: (default is 120)
HYD-1 #
```

Enabling Passive Interface on RIP

To disable sending of RIP updates packet on selected Interface. (i.e. FastEthernet Interface) we use the passive interface command.

Example – HYD-1

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **router rip**
HYD-1 (config-router) # **passive-interface fastethernet 0/0**
HYD-1 (config-router) # **end**

After enabling passive interface, again verify the behaviour of RIP Update packets by enabling debug commands. Now you will not see the following line in the debug outputs.

RIP: sending v2 update to 224.0.0.9 via fastethernet 0/0

This means you have successfully disabled sending of RIP updates packet on selected Interface.

HYD-1 – Verification:

HYD-1 # **show ip protocols**

```
*** IP Routing is NSF aware ***

Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 26 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface           Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0       2     2
    Serial0/0/0           2     2
```

```
  Serial0/0/1        2   2
  Loopback1          2   2
  Loopback2          2   2
  Loopback3          2   2
 Automatic network summarization is in effect
 Maximum path: 4
 Routing for Networks:
  172.16.0.0
  172.17.0.0
  192.168.202.0
 Passive Interface(s):
  FastEthernet0/0
 Routing Information Sources:
  Gateway       Distance      Last Update
  172.16.0.1       120      00:00:01
  172.17.0.2       120      00:00:23
 Distance: (default is 120)
HYD-1 #
```

Verify RIP Database

HYD-1 # **show ip rip database**

```
16.0.0.0/8    auto-summary
16.0.0.0/8
   [1] via 172.16.0.1, 00:00:01, Serial0/0/1
17.0.0.0/8    auto-summary
17.1.1.0/24    directly connected, Loopback1
17.1.2.0/24    directly connected, Loopback2
17.1.3.0/24    directly connected, Loopback3
18.0.0.0/8    auto-summary
18.0.0.0/8
   [1] via 172.17.0.2, 00:00:23, Serial0/0/0
172.16.0.0/16    auto-summary
172.16.0.0/16    directly connected, Serial0/0/1
172.17.0.0/16    auto-summary
172.17.0.0/16    directly connected, Serial0/0/0
172.18.0.0/16    auto-summary
172.18.0.0/16
   [1] via 172.17.0.2, 00:00:23, Serial0/0/0
   [1] via 172.16.0.1, 00:00:01, Serial0/0/1
192.168.201.0/24    auto-summary
192.168.201.0/24
   [1] via 172.16.0.1, 00:00:01, Serial0/0/1
192.168.202.0/24    auto-summary
192.168.202.0/24    directly connected, FastEthernet0/0
192.168.203.0/24    auto-summary
192.168.203.0/24
   [1] via 172.17.0.2, 00:00:23, Serial0/0/0
```

Disabling RIP Auto Summary

By default RIP auto summary is enabled on CISCO IOS prior to 12.4. Let's try to understand the difference in routing table output when auto summary is enabled and when it is disabled.

Verify Routing Table on HYD-1

```
HYD-1 # show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is not set

R    16.0.0.0/8 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
     17.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       17.1.1.0/24 is directly connected, Loopback1
L       17.1.1.1/32 is directly connected, Loopback1
C       17.1.2.0/24 is directly connected, Loopback2
L       17.1.2.1/32 is directly connected, Loopback2
C       17.1.3.0/24 is directly connected, Loopback3
L       17.1.3.1/32 is directly connected, Loopback3
R    18.0.0.0/8 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/16 is directly connected, Serial0/0/1
L       172.16.0.2/32 is directly connected, Serial0/0/1
     172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.17.0.0/16 is directly connected, Serial0/0/0
L       172.17.0.1/32 is directly connected, Serial0/0/0
R    172.18.0.0/16 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
                   [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R    192.168.201.0/24 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
     192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.202.0/24 is directly connected, FastEthernet0/0
L       192.168.202.1/32 is directly connected, FastEthernet0/0
R    192.168.203.0/24 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
HYD-1 #
```

Disable Auto Summary on CHE

```
CHE # configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
CHE (config) # router rip
CHE (config-router)# no auto-summary
CHE (config-router)# end
```

Verify Routing Table on HYD-1

```
HYD-1 # show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      16.0.0.0/24 is subnetted, 3 subnets
R        16.1.1.0 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R        16.1.2.0 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R        16.1.3.0 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
      17.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C        17.1.1.0/24 is directly connected, Loopback1
L        17.1.1.1/32 is directly connected, Loopback1
C        17.1.2.0/24 is directly connected, Loopback2
L        17.1.2.1/32 is directly connected, Loopback2
C        17.1.3.0/24 is directly connected, Loopback3
L        17.1.3.1/32 is directly connected, Loopback3
R     18.0.0.0/8 [120/1] via 172.17.0.2, 00:00:24, Serial0/0/0
      172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.16.0.0/16 is directly connected, Serial0/0/1
L        172.16.0.2/32 is directly connected, Serial0/0/1
      172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.17.0.0/16 is directly connected, Serial0/0/0
L        172.17.0.1/32 is directly connected, Serial0/0/0
R     172.18.0.0/16 [120/1] via 172.17.0.2, 00:00:13, Serial0/0/0
                    [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
R     192.168.201.0/24 [120/1] via 172.16.0.1, 00:00:01, Serial0/0/1
      192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.202.0/24 is directly connected, FastEthernet0/0
L        192.168.202.1/32 is directly connected, FastEthernet0/0
R     192.168.203.0/24 [120/1] via 172.17.0.2, 00:00:13, Serial0/0/0

HYD-1 #
```

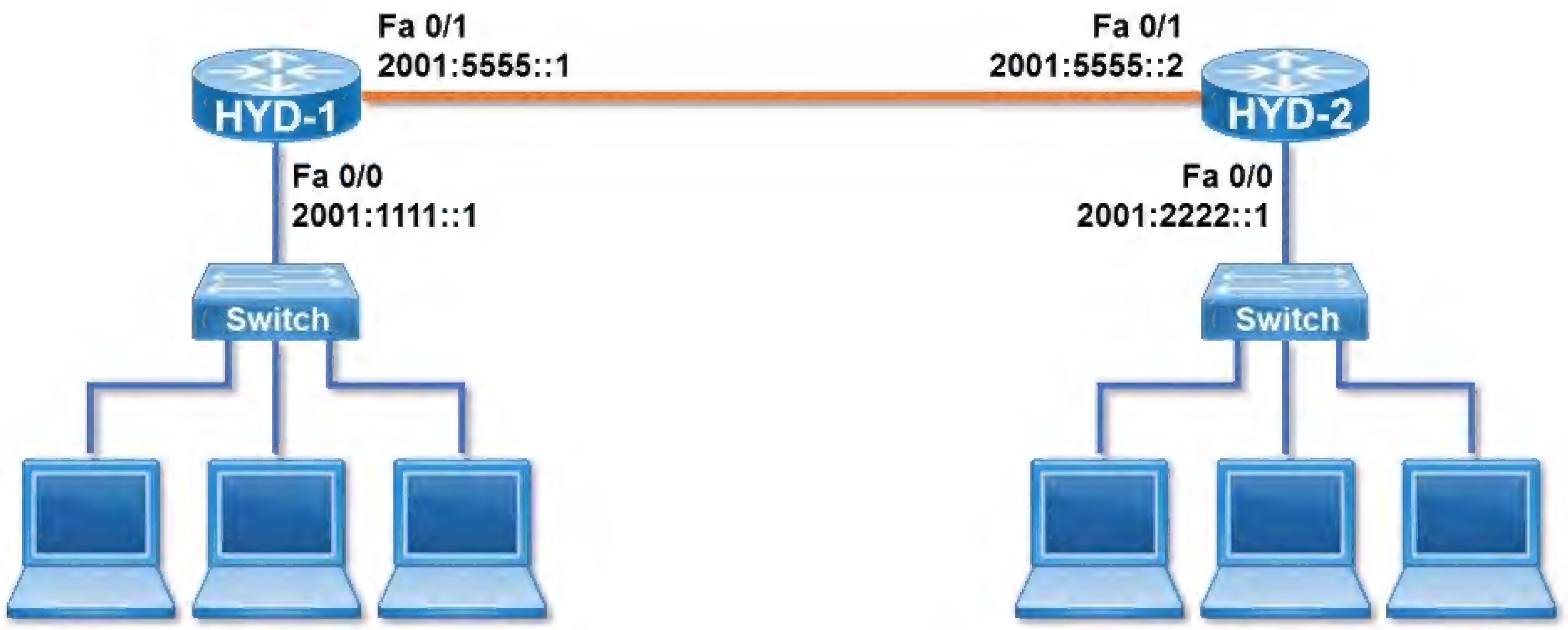
LAB 11: RIPng ON IPv6 NETWORK

OBJECTIVE:

To configure RIPng routing for communicating between different IPv6 networks on different routers.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	2001:1111::/64
Fa 0/1	2001:5555::/64

Interface	Network ID / Mask
Fa 0/0	2001:2222::/64
Fa 0/1	2001:5555::/64

Pre-requisite: WAN Interface configuration to be done on the router (LAB – 7)

TASK:

- Configure RIPng on IPv6 Network
- Verify RIPng on IPv6 Network
- Verify Communication between the IPv6 networks
- Verify RIPng protocol default settings

Configure RIPng on IPv6 Network

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ipv6 unicast-routing**
HYD-1 (config) # **ipv6 router rip cisco**
HYD-1 (config-rtr) # **exit**
HYD-1 (config) # **interface fastethernet 0/0**
HYD-1 (config-if) # **ipv6 rip cisco enable**
HYD-1 (config-if) # **exit**
HYD-1 (config) # **interface fastethernet 0/1**
HYD-1 (config-if) # **ipv6 rip cisco enable**
HYD-1 (config-if) # **end**
HYD-1 #

HYD-2 – Configuration

HYD-2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-2 (config) # **ipv6 unicast-routing**
HYD-2 (config) # **ipv6 router rip cisco**
HYD-2 (config-rtr) # **exit**
HYD-2 (config) # **interface fastethernet 0/0**
HYD-2 (config-if) # **ipv6 rip cisco enable**
HYD-2 (config-if) # **exit**
HYD-2 (config) # **interface fastethernet 0/1**
HYD-2 (config-if) # **ipv6 rip cisco enable**
HYD-2 (config-if) # **end**
HYD-2 #

Verify RIPng on IPv6 Network

Once RIP routing is enabled, IPv6 Networks learnt via **RIP** are added into the routing table. **"R"** represents **RIP route.**

HYD-1 – Verification:

```
HYD-1 # show ipv6 route
IPv6 Routing Table - default - 6 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
C   2001:1111::/64 [0/0]
     via FastEthernet0/0, directly connected
L   2001:1111::1/128 [0/0]
     via FastEthernet0/0, receive
R   2001:2222::/64 [120/2]
     via FE80::21C:F6FF:FE85:1FA1, FastEthernet0/1
C   2001:5555::/64 [0/0]
     via FastEthernet0/1, directly connected
L   2001:5555::1/128 [0/0]
     via FastEthernet0/1, receive
L   FF00::/8 [0/0]
     via Null0, receive
HYD-1 #
```

HYD-2 – Verification:

```
HYD-2 # show ipv6 route
IPv6 Routing Table - default - 6 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
R   2001:1111::/64 [120/2]
     via FE80::21C:F6FF:FE85:1FA1, FastEthernet0/1
C   2001:2222::/64 [0/0]
     via FastEthernet0/0, directly connected
L   2001:2222::1/128 [0/0]
     via FastEthernet0/0, receive
C   2001:5555::/64 [0/0]
     via FastEthernet0/1, directly connected
L   2001:5555::2/128 [0/0]
     via FastEthernet0/1, receive
L   FF00::/8 [0/0]
     via Null0, receive
HYD-2#
```

Verify communication between the IPv6 networks

Verification from a Computer in HYD-1 Network

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms

Verification from a Computer in HYD-2 Network

ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)

PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=62 time=0.336 ms

From a Computer in HYD-1 Network trace communication path to a Computer in HYD-2 Network

tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)

```
traceroute to 2001:2222::10 (2001:2222::10), 30 hops max, 80 byte packets
 1  2001:1111::1 (2001:1111::1)  2.825 ms  3.239 ms  3.665 ms
 2  2001:5555::2 (2001:5555::2)  9.086 ms  9.393 ms  9.642 ms
 3  2001:2222::10 (2001:2222::10)  9.781 ms  10.474 ms  10.720 ms
```

From a Computer in HYD-2 Network trace communication path to a Computer in HYD-1 Network

tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)

```
traceroute to 2001:1111::10 (2001:1111::10), 30 hops max, 80 byte packets
 1  2001:2222::1 (2001:2222::1)  1.071 ms  1.152 ms  1.238 ms
 2  2001:5555::1 (2001:5555::1)  4.303 ms  4.930 ms  5.419 ms
 3  2001:1111::10 (2001:1111::10)  10.832 ms  11.444 ms  11.541 ms
```

LAB 12: OSPF ON IPv4 NETWORK

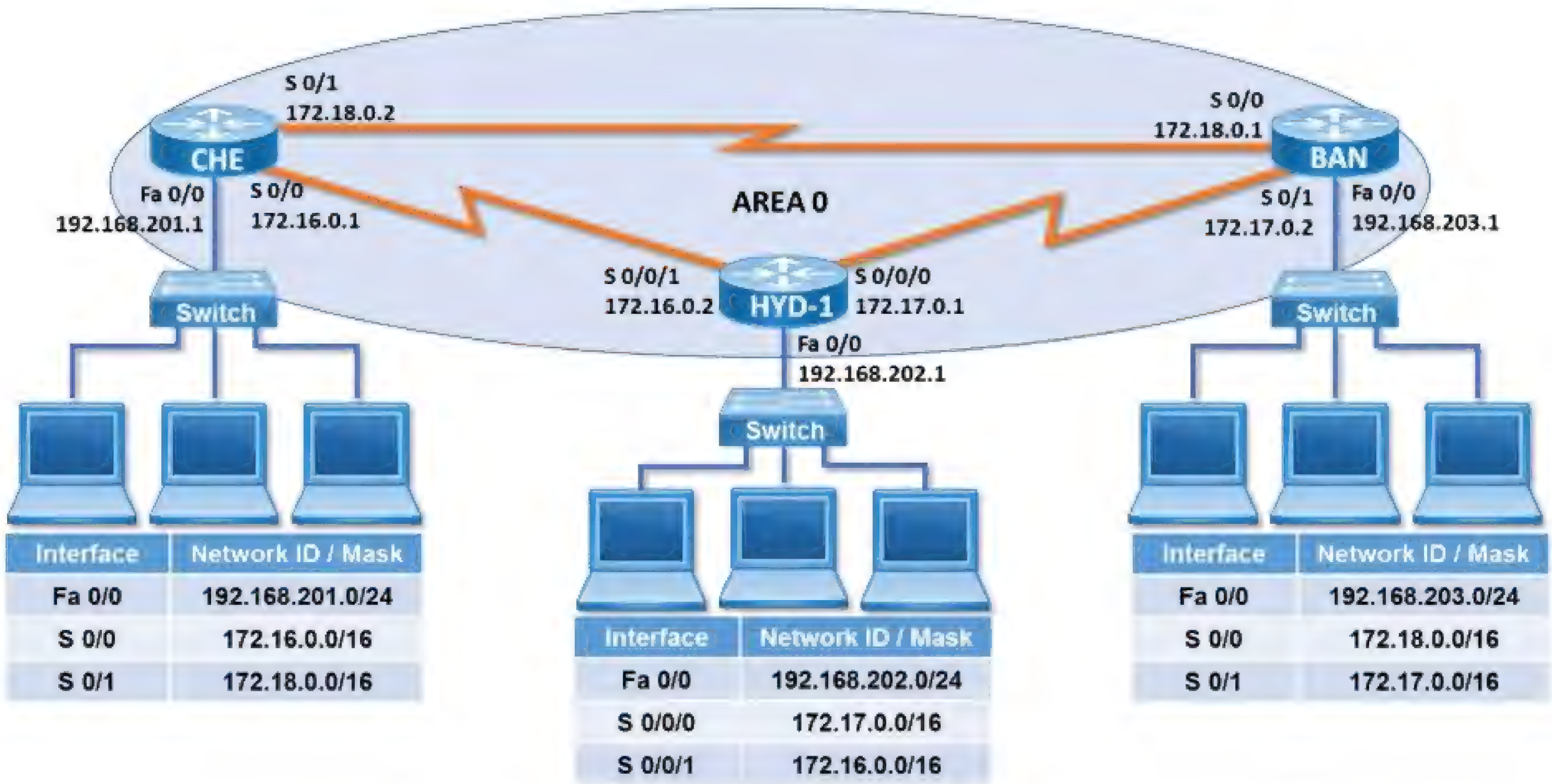
OBJECTIVE:

To configure OSPF Routing in a single area.

To understand how OSPF works and fine tune OSPF configuration.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below:



Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)

TASK:

- Configure OSPF – Single Area on IPv4 network
- Verify OSPF – Single Area on IPv4 network
- Verify Communication between the IPv4 networks
- Verify OSPF Neighbour and Topology Table
- Verify OSPF protocol default settings
- Verify OSPF Packets on IPv4 network
- Enable Passive Interface on IPv4 network
- Configuring OSPF Cost metric for an interface

Configure OSPF – Single Area on IPv4 Network

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip routing**
CHE (config) # **router ospf 1**
CHE (config-router) # **router-id 1.1.1.1**
CHE (config-router) # **network 192.168.201.0 0.0.0.255 area 0**
CHE (config-router) # **network 172.16.0.0 0.0.255.255 area 0**
CHE (config-router) # **network 172.18.0.0 0.0.255.255 area 0**
CHE (config-router) # **end**
CHE #

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip routing**
HYD-1 (config) # **router ospf 2**
HYD-1 (config-router) # **router-id 2.2.2.2**
HYD-1 (config-router) # **network 192.168.202.0 0.255.255.255 area 0**
HYD-1 (config-router) # **network 172.16.0.0 0.0.255.255 area 0**
HYD-1 (config-router) # **network 172.17.0.0 0.0.255.255 area 0**
HYD-1 (config-router) # **end**
HYD-1 #

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # **ip routing**
BAN (config) # **router ospf 3**
BAN (config-router) # **router-id 3.3.3.3**
BAN (config-router) # **network 192.168.203.0 0.0.0.255 area 0**
BAN (config-router) # **network 172.17.0.0 0.0.255.255 area 0**
BAN (config-router) # **network 172.18.0.0 0.0.255.255 area 0**
BAN (config-router) # **end**
BAN #

Verify OSPF – Single Area on IPv4 Network

Once OSPF routing is enabled, the IPv4 Networks learned through **OSPF** are added into the routing table. **"O"** represents an **OSPF route.**

CHE – Verification:

CHE # **show ip route**

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

O    172.17.0.0/16 [110/128] via 172.16.0.2, 00:00:26, Serial0/0
                   [110/128] via 172.18.0.1, 00:00:26, Serial0/1
C    172.16.0.0/16 is directly connected, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/1
C    192.168.201.0/24 is directly connected, FastEthernet0/0
O    192.168.202.0/24 [110/64] via 172.16.0.2, 00:00:26, Serial0/0
O    192.168.203.0/24 [110/64] via 172.18.0.1, 00:00:26, Serial0/1
CHE #
```

HYD-1 – Verification:

HYD-1 # **show ip route**

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.16.0.0/16 is directly connected, Serial0/0/1
L        172.16.0.2/32 is directly connected, Serial0/0/1
      172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.17.0.0/16 is directly connected, Serial0/0/0
L        172.17.0.1/32 is directly connected, Serial0/0/0
```

```
O    172.18.0.0/16 [110/128] via 172.17.0.2, 00:01:21, Serial0/0/0
                   [110/128] via 172.16.0.1, 00:03:17, Serial0/0/1
O    192.168.201.0/24 [110/64] via 172.16.0.1, 00:03:17, Serial0/0/1
     192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.202.0/24 is directly connected, FastEthernet0/0
L       192.168.202.1/32 is directly connected, FastEthernet0/0
O    192.168.203.0/24 [110/64] via 172.17.0.2, 00:01:21, Serial0/0/0
HYD-1 #
```

BAN – Verification:

BAN # **show ip route**

```
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    172.17.0.0/16 is directly connected, Serial0/1
O    172.16.0.0/16 [110/128] via 172.17.0.1, 00:01:40, Serial0/1
                   [110/128] via 172.18.0.2, 00:01:40, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/0
O    192.168.201.0/24 [110/64] via 172.18.0.2, 00:01:40, Serial0/0
O    192.168.202.0/24 [110/64] via 172.17.0.1, 00:01:40, Serial0/1
C    192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #
```

Verify communication between the IPv4 networks

Verification from a Computer in HYD-1 Network

ping 192.168.201.10

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms
```

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

Repeat the above ping verification from a computer in CHE and BAN Network.

From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

Repeat the above trace communication path from a computer in CHE and BAN Network.

Verify OSPF Neighbour and Database Table

CHE – Verification:

CHE # **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
2.2.2.2	1	FULL/ -	00:00:33	172.16.0.2	Serial0/0
3.3.3.3	1	FULL/ -	00:00:37	172.18.0.1	Serial0/1

CHE #

CHE # **show ip ospf database**

OSPF Router with ID (1.1.1.1) (Process ID 1)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	56	0x80000005	0x385F	5
2.2.2.2	2.2.2.2	48	0x80000005	0xD3A9	5
3.3.3.3	3.3.3.3	46	0x80000004	0x87B	5

CHE #

HYD-1 – Verification:

HYD-1 # **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
3.3.3.3	0	FULL/ -	00:00:32	172.17.0.2	Serial0/0/0
1.1.1.1	0	FULL/ -	00:00:31	172.16.0.1	Serial0/0/1

HYD-1 #

HYD-1 # **show ip ospf database**

OSPF Router with ID (2.2.2.2) (Process ID 2)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	56	0x80000005	0x385F	5
2.2.2.2	2.2.2.2	48	0x80000005	0xD3A9	5
3.3.3.3	3.3.3.3	46	0x80000004	0x87B	5

HYD-1 #

BAN – Verification:

BAN # **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
1.1.1.1	1	FULL/ -	00:00:39	172.18.0.2	Serial0/0
2.2.2.2	1	FULL/ -	00:00:33	172.17.0.1	Serial0/1

BAN #

BAN # **show ip ospf database**

OSPF Router with ID (3.3.3.3) (Process ID 3)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	56	0x80000005	0x385F	5
2.2.2.2	2.2.2.2	48	0x80000005	0xD3A9	5
3.3.3.3	3.3.3.3	46	0x80000004	0x87B	5

BAN #

Verify OSPF protocol default settings

Example - HYD-1

```
HYD-1 # show ip protocols
*** IP Routing is NSF aware ***
Routing Protocol is "ospf 2"
 Outgoing update filter list for all interfaces is not set
 Incoming update filter list for all interfaces is not set
 Router ID 2.2.2.2
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 Maximum path: 4
 Routing for Networks:
  172.16.0.0 0.0.255.255 area 0
  172.17.0.0 0.0.255.255 area 0
  192.168.202.0 0.0.0.255 area 0
 Routing Information Sources:
  Gateway       Distance      Last Update
  3.3.3.3          110      00:01:20
  1.1.1.1          110      00:03:16
 Distance: (default is 110)
HYD-1#
```

Verify OSPF Hello Packets

Verify default behaviour of OSPF Hello packets by enabling debug commands

Example - HYD-1

```
HYD-1 # terminal monitor
HYD-1 # debug ip ospf hello
OSPF hello events debugging is on
HYD-1#
*Jul 22 20:00:44.967: OSPF: Rcv hello from 192.168.203.1 area 0 from Serial0/0/0 172.17.0.2
*Jul 22 20:00:44.967: OSPF: End of hello processing
*Jul 22 20:00:46.011: OSPF: Send hello to 224.0.0.5 area 0 on GigabitEthernet0/0 from 10.0.0.1
*Jul 22 20:00:47.959: OSPF: Rcv hello from 192.168.201.1 area 0 from Serial0/0/1 172.16.0.1
*Jul 22 20:00:47.959: OSPF: End of hello processing
*Jul 22 20:00:49.779: OSPF: Send hello to 224.0.0.5 area 0 on Serial0/0/0 from 172.17.0.1
*Jul 22 20:00:51.263: OSPF: Send hello to 224.0.0.5 area 0 on Serial0/0/1 from 172.16.0.2
*Jul 22 20:00:54.967: OSPF: Rcv hello from 192.168.203.1 area 0 from Serial0/0/0 172.17.0.2
*Jul 22 20:00:54.967: OSPF: End of hello processing
*Jul 22 20:00:55.279: OSPF: Send hello to 224.0.0.5 area 0 on GigabitEthernet0/0 from 10.0.0.1
*Jul 22 20:00:57.959: OSPF: Rcv hello from 192.168.201.1 area 0 from Serial0/0/1 172.16.0.1
*Jul 22 20:00:57.959: OSPF: End of hello processing
*Jul 22 20:00:59.011: OSPF: Send hello to 224.0.0.5 area 0 on Serial0/0/0 from 172.17.0.1
*Jul 22 20:01:00.963: OSPF: Send hello to 224.0.0.5 area 0 on Serial0/0/1 from 172.16.0.2
HYD-1 #

HYD-1 # undebug  all
HYD-1 # terminal no monitor
```

Enable passive interface on OSPF

This command disables OSPF Hello packets from being sent on that interface.

Example - HYD-1

HYD-1# **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **router ospf 2**
HYD-1 (config-router) # **passive-interface FastEthernet 0/0**
HYD-1 (config-router) # **end**

After enabling above commands, again verify default behaviour of OSPF Hello packets by enabling debug commands. Now you will not able see the following line in the debug outputs.

OSPF: Send hello to 224.0.0.5 area 0 on FastEthernet 0/0 from 192.168.202.1

This means that you have successfully disabled sending of OSPF Hello packet on selected Interface.

HYD-1 – Verification:

```
HYD-1 # show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "ospf 2"
 Outgoing update filter list for all interfaces is not set
 Incoming update filter list for all interfaces is not set
 Router ID 2.2.2.2
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 Maximum path: 4
 Routing for Networks:
  172.16.0.0 0.0.255.255 area 0
  172.17.0.0 0.0.255.255 area 0
  192.168.202.0 0.0.0.255 area 0
Passive Interface(s):
  FastEthernet0/0
Routing Information Sources:
  Gateway      Distance     Last Update
  3.3.3.3        110      00:01:20
  1.1.1.1        110      00:03:16
 Distance: (default is 110)
```

Configuring OSPF Cost metric for an interface

This command will configure OSPF Cost metric for an interface.

Verification - HYD-1

HYD-1 # **show ip ospf interface brief**

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs F/C
Se0/0/0	1	0	172.17.0.1/16	64	P2P	1/1
Se0/0/1	1	0	172.16.0.2/16	64	P2P	1/1

HYD-1 #

Example - HYD-1

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **interface serial 0/0/0**
HYD-1 (config-router) # **ip ospf cost 100**
HYD-1 (config-router) # **end**
HYD-1 #

Verification - HYD-1

HYD-1 # **show ip ospf interface brief**

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs F/C
Se0/0/0	1	0	172.17.0.1/16	100	P2P	1/1
Se0/0/1	1	0	172.16.0.2/16	64	P2P	1/1

HYD-1 #

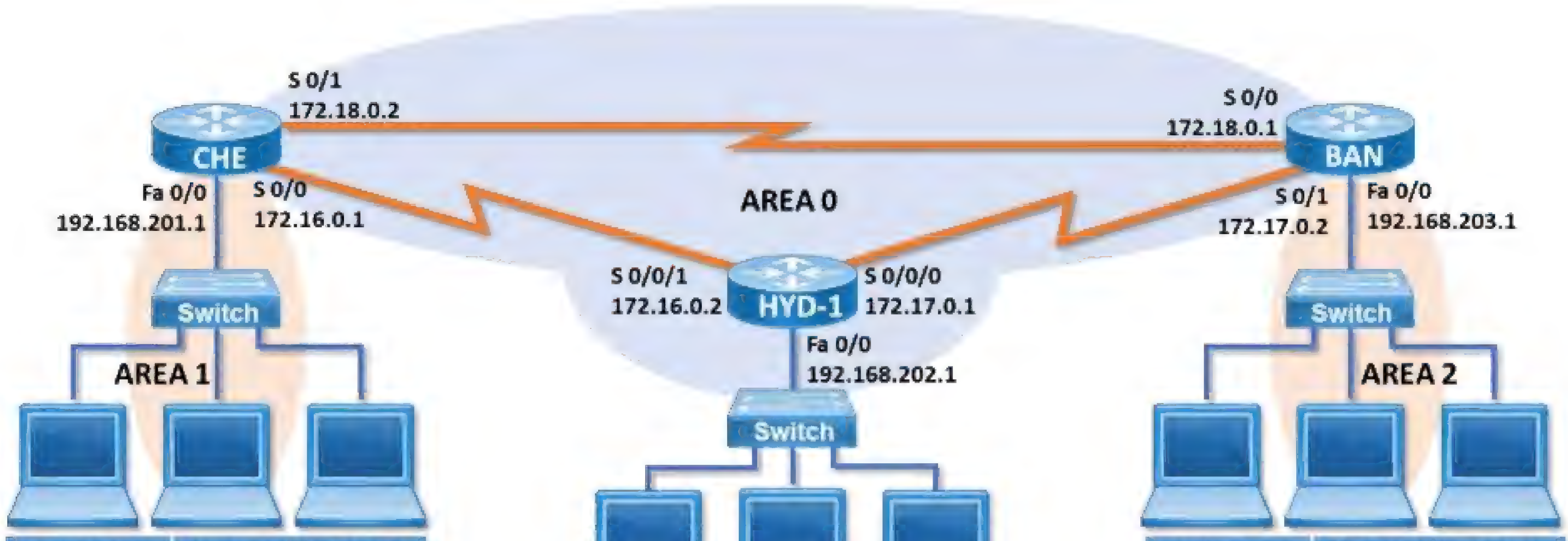
LAB 13: OSPF – MULTIPLE AREA ON IPv4 NETWORK

OBJECTIVE:

To configure OSPF with a backbone area (area 0) and multiple areas connected to the backbone.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below:



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	172.16.0.0/16
S 0/1	172.18.0.0/16

Interface	Network ID / Mask
Fa 0/0	192.168.202.0/24
S 0/0/0	172.17.0.0/16
S 0/0/1	172.16.0.0/16

Interface	Network ID / Mask
Fa 0/0	192.168.203.0/24
S 0/0	172.18.0.0/16
S 0/1	172.17.0.0/16

Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)

TASK:

- Configure OSPF – Multiple Area on IPv4 network
- Verify OSPF – Multiple Area on IPv4 network
- Verify Communication between the IPv4 networks
- Verify OSPF Neighbour and Topology Table

Configure OSPF Routing with backbone area and multiple connected areas on IPv4 Network

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip routing**
CHE (config) # **router ospf 1**
CHE (config-router) # **router-id 1.1.1.1**
CHE (config-router) # **network 192.168.201.0 0.0.0.255 area 1**
CHE (config-router) # **network 172.16.0.0 0.0.255.255 area 0**
CHE (config-router) # **network 172.18.0.0 0.0.255.255 area 0**
CHE (config-router) # **end**
CHE #

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip routing**
HYD-1 (config) # **router ospf 2**
HYD-1 (config-router) # **router-id 2.2.2.2**
HYD-1 (config-router) # **network 192.168.202.0 0.255.255.255 area 0**
HYD-1 (config-router) # **network 172.16.0.0 0.0.255.255 area 0**
HYD-1 (config-router) # **network 172.17.0.0 0.0.255.255 area 0**
HYD-1 (config-router) # **end**
HYD-1 #

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # **ip routing**
BAN (config) # **router ospf 3**
BAN (config-router) # **router-id 3.3.3.3**
BAN (config-router) # **network 192.168.203.0 0.0.0.255 area 2**
BAN (config-router) # **network 172.17.0.0 0.0.255.255 area 0**
BAN (config-router) # **network 172.18.0.0 0.0.255.255 area 0**
BAN (config-router) # **end**
BAN #

Verify OSPF – Multiple Area on IPv4 Network

Once OSPF routing is enabled, IP networks learned through **OSPF** are added into the routing table.

"IA" represents **OSPF Inter Area route.**

CHE – Verification:

CHE # **show ip route**

```
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

O    172.17.0.0/16 [110/128] via 172.18.0.1, 00:00:50, Serial0/1
                   [110/128] via 172.16.0.2, 00:00:50, Serial0/0
C    172.16.0.0/16 is directly connected, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/1
C    192.168.201.0/24 is directly connected, FastEthernet0/0
O    192.168.202.0/24 [110/64] via 172.16.0.2, 00:00:50, Serial0/0
O IA 192.168.203.0/24 [110/64] via 172.18.0.1, 00:00:49, Serial0/1
CHE #
```

HYD-1 – Verification:

HYD-1 # **show ip route**

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
          o - ODR, P - periodic downloaded static route, + - replicated route

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/16 is directly connected, Serial0/0/1
L       172.16.0.2/32 is directly connected, Serial0/0/1
     172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.17.0.0/16 is directly connected, Serial0/0/0
L       172.17.0.1/32 is directly connected, Serial0/0/0
O    172.18.0.0/16 [110/128] via 172.17.0.2, 00:02:23, Serial0/0/0
                   [110/128] via 172.16.0.1, 00:02:23, Serial0/0/1
```

O IA 192.168.201.0/24 [110/64] via 172.16.0.1, 00:02:23, Serial0/0/1
192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.202.0/24 is directly connected, FastEthernet0/0
L 192.168.202.1/32 is directly connected, FastEthernet0/0
O IA 192.168.203.0/24 [110/64] via 172.17.0.2, 00:01:25, Serial0/0/0
HYD-1 #

BAN – Verification:

BAN # **show ip route**

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS
ia - IS-IS inter area, * - candidate default, U - per-user sta
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C 172.17.0.0/16 is directly connected, Serial0/1
O 172.16.0.0/16 [110/128] via 172.18.0.2, 00:02:02, Serial0/0
[110/128] via 172.17.0.1, 00:02:02, Serial0/1
C 172.18.0.0/16 is directly connected, Serial0/0
O IA 192.168.201.0/24 [110/64] via 172.18.0.2, 00:02:02, Serial0/0
O 192.168.202.0/24 [110/64] via 172.17.0.1, 00:02:02, Serial0/1
C 192.168.203.0/24 is directly connected, FastEthernet0/0
BAN #

Verify communication between the IPv4 networks

Verification from a Computer in HYD-1 Network

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

Repeat the above ping verification from a computer in CHE and BAN Network.

From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

Repeat the above trace communication path from a computer in CHE and BAN Network.

Verify OSPF Neighbour and Database Table

CHE – Verification:

CHE # **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
2.2.2.2	1	FULL/ -	00:00:33	172.16.0.2	Serial0/0
3.3.3.3	1	FULL/ -	00:00:37	172.18.0.1	Serial0/1

CHE #

CHE # **show ip ospf database**

OSPF Router with ID (1.1.1.1) (Process ID 1)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	56	0x80000005	0x385F	4
2.2.2.2	2.2.2.2	48	0x80000005	0xD3A9	5
3.3.3.3	3.3.3.3	46	0x80000004	0x87B	4

Summary Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
192.168.201.0	1.1.1.1	586	0x80000001	0x655
192.168.203.0	1.1.1.1	586	0x80000001	0x655

Router Link States (Area 1)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	596	0x80000001	0x4B98	1

Summary Net Link States (Area 1)

Link ID	ADV Router	Age	Seq#	Checksum
192.168.202.0	1.1.1.1	379	0x80000001	0x7312
172.16.0.0	1.1.1.1	364	0x80000004	0x6070
172.17.0.0	1.1.1.1	145	0x80000003	0xD8B7
172.18.0.0	1.1.1.1	116	0x80000004	0x4886
192.168.203.0	1.1.1.1	121	0x80000001	0x23FF

CHE #

HYD-1 – Verification:

HYD-1 # **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
3.3.3.3	0	FULL/ -	00:00:32	172.17.0.2	Serial0/0/0
1.1.1.1	0	FULL/ -	00:00:31	172.16.0.1	Serial0/0/1

HYD-1 #

HYD-1 # **show ip ospf database**

OSPF Router with ID (2.2.2.2) (Process ID 2)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	56	0x80000005	0x385F	4
2.2.2.2	2.2.2.2	48	0x80000005	0xD3A9	5
3.3.3.3	3.3.3.3	46	0x80000004	0x87B	4

Summary Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
192.168.201.0	1.1.1.1	586	0x80000001	0x655
192.168.203.0	3.3.3.3	586	0x80000001	0x655

HYD-1 #

BAN – Verification:

BAN # **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
1.1.1.1	1	FULL/ -	00:00:39	172.18.0.2	Serial0/0
2.2.2.2	1	FULL/ -	00:00:33	172.17.0.1	Serial0/1

BAN #

BAN # **show ip ospf database**

OSPF Router with ID (3.3.3.3) (Process ID 3)

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	56	0x80000005	0x385F	4
2.2.2.2	2.2.2.2	48	0x80000005	0xD3A9	5
3.3.3.3	3.3.3.3	46	0x80000004	0x87B	4

Summary Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
192.168.201.0	1.1.1.1	586	0x80000001	0x655
192.168.203.0	1.1.1.1	586	0x80000001	0x655

Router Link States (Area 2)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
3.3.3.3	3.3.3.3	596	0x80000001	0x4B98	1

Summary Net Link States (Area 2)

Link ID	ADV Router	Age	Seq#	Checksum
192.168.202.0	3.3.3.3	379	0x80000001	0x7312
172.16.0.0	3.3.3.3	364	0x80000004	0x6070
172.17.0.0	3.3.3.3	145	0x80000003	0xD8B7
172.18.0.0	3.3.3.3	116	0x80000004	0x4886
192.168.203.0	3.3.3.3	121	0x80000001	0x23FF

BAN #

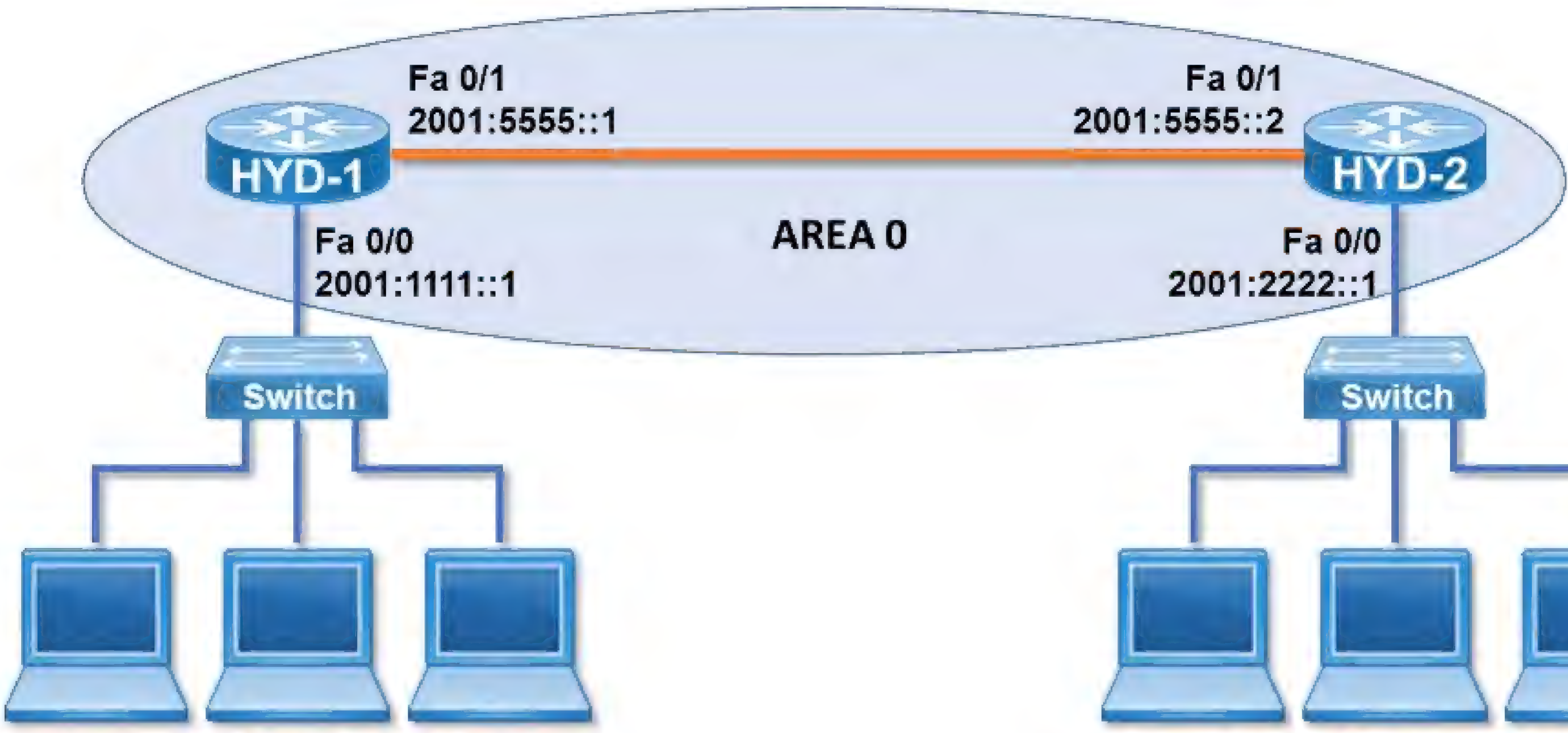
LAB 14: OSPFv3 ON IPv6 NETWORK

OBJECTIVE:

To configure OSPFv3 Routing in a single area.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below:



Interface	Network ID / Mask
Fa 0/0	2001:1111::/64
Fa 0/1	2001:5555::/64

Interface	Network ID / Mask
Fa 0/0	2001:2222::/64
Fa 0/1	2001:5555::/64

Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)

TASK:

- Configure OSPFv3 on IPv6 network
- Verify OSPFv3 on IPv6 network
- Verify communication between the IPv6 networks
- Verify OSPFv3 Neighbor and Topology Table on IPv6 network

Configure OSPFv3 on IPv6 Network

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ipv6 unicast-routing**
HYD-1 (config) # **ipv6 router ospf 2**
HYD-1 (config-rtr) # **router-id 11.11.11.11**
HYD-1 (config-rtr) # **exit**
HYD-1 (config) # **interface fastethernet 0/0**
HYD-1 (config-if) # **ipv6 ospf 2 area 0**
HYD-1 (config-if) # **exit**
HYD-1 (config) # **interface fastethernet 0/1**
HYD-1 (config-if) # **ipv6 ospf 2 area 0**
HYD-1 (config-if) # **end**
HYD-1 #

HYD-2 – Configuration

HYD-2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-2 (config) # **ipv6 unicast-routing**
HYD-2 (config) # **ipv6 router ospf 2**
HYD-2 (config-rtr) # **router-id 22.22.22.22**
HYD-2 (config-rtr) # **exit**
HYD-2 (config) # **interface fastethernet 0/0**
HYD-2 (config-if) # **ipv6 ospf 2 area 0**
HYD-2 (config-if) # **exit**
HYD-2 (config) # **interface fastethernet 0/1**
HYD-2 (config-if) # **ipv6 ospf 2 area 0**
HYD-2 (config-if) # **end**
HYD-2 #

Verify OSPFv3 on IPv6 Network

Once OSPF routing is enabled, IPv6 Networks learnt via **OSPF** are added into the routing table. **"O"** represents **OSPF route.**

HYD-1 – Verification:

```
HYD-1 # show ip route
IPv6 Routing Table - default - 6 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
C  2001:1111::/64 [0/0]
    via FastEthernet0/0, directly connected
L  2001:1111::1/128 [0/0]
    via FastEthernet0/0, receive
O  2001:2222::/64 [110/2]
    via FE80::21C:F6FF:FE85:1FA1, FastEthernet0/1
C  2001:5555::/64 [0/0]
    via FastEthernet0/1, directly connected
L  2001:5555::1/128 [0/0]
    via FastEthernet0/1, receive
L  FF00::/8 [0/0]
    via Null0, receive
HYD-1 #
```

HYD-2 – Verification:

```
HYD-2 # show ipv6 route
IPv6 Routing Table - default - 6 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
O  2001:1111::/64 [110/2]
    via FE80::21B:2AFF:FEA4:2FE9, FastEthernet0/1
C  2001:2222::/64 [0/0]
    via FastEthernet0/0, directly connected
L  2001:2222::1/128 [0/0]
    via FastEthernet0/0, receive
C  2001:5555::/64 [0/0]
    via FastEthernet0/1, directly connected
L  2001:5555::2/128 [0/0]
    via FastEthernet0/1, receive
L  FF00::/8 [0/0]
    via Null0, receive
HYD-2#
```

Verify communication between the IPv6 networks

Verification from a Computer in HYD-1 Network

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms

Verification from a Computer in HYD-2 Network

ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)

PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=62 time=0.336 ms

From a Computer in HYD-1 Network trace communication path to a Computer in HYD-2 Network

`tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)`

```
traceroute to 2001:2222::10 (2001:2222::10), 30 hops max, 80 byte packets
 1  2001:1111::1 (2001:1111::1)  2.825 ms  3.239 ms  3.665 ms
 2  2001:5555::2 (2001:5555::2)  9.086 ms  9.393 ms  9.642 ms
 3  2001:2222::10 (2001:2222::10)  9.781 ms  10.474 ms  10.720 ms
```

From a Computer in HYD-2 Network trace communication path to a Computer in HYD-1 Network

`tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)`

```
traceroute to 2001:1111::10 (2001:1111::10), 30 hops max, 80 byte packets
 1  2001:2222::1 (2001:2222::1)  1.071 ms  1.152 ms  1.238 ms
 2  2001:5555::1 (2001:5555::1)  4.303 ms  4.930 ms  5.419 ms
 3  2001:1111::10 (2001:1111::10)  10.832 ms  11.444 ms  11.541 ms
```

Verify OSPF Neighbour and Database Table on IPv6 Network

HYD-1 – Verification:

HYD-1 # **show ipv6 ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Interface ID	Interface
22.22.22.22	1	FULL/DR	00:00:34	4	FastEthernet0/1

HYD-1 #

HYD-1 # **show ipv6 ospf database**

OSPFv3 Router with ID (11.11.11.11) (Process ID 2)

Router Link States (Area 0)

ADV Router	Age	Seq#	Fragment ID	Link count	Bits
11.11.11.11	234	0x80000002	0	1	None
22.22.22.22	233	0x80000002	0	1	None

Net Link States (Area 0)

ADV Router	Age	Seq#	Link ID	Rtr count
22.22.22.22	233	0x80000001	4	2

HYD-2#

HYD-2 – Verification:

HYD-2 # **show ipv6 ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Interface ID	Interface
11.11.11.11	1	FULL/BDR	00:00:34	4	FastEthernet0/1

HYD-2 #

HYD-2 # **show ipv6 ospf database**

OSPFv3 Router with ID (22.22.22.22) (Process ID 2)

Router Link States (Area 0)

ADV Router	Age	Seq#	Fragment ID	Link count	Bits
11.11.11.11	234	0x80000002	0	1	None
22.22.22.22	233	0x80000002	0	1	None

Net Link States (Area 0)

ADV Router	Age	Seq#	Link ID	Rtr count
22.22.22.22	233	0x80000001	4	2

HYD-2#

LAB 15: EIGRP ON IPv4 network

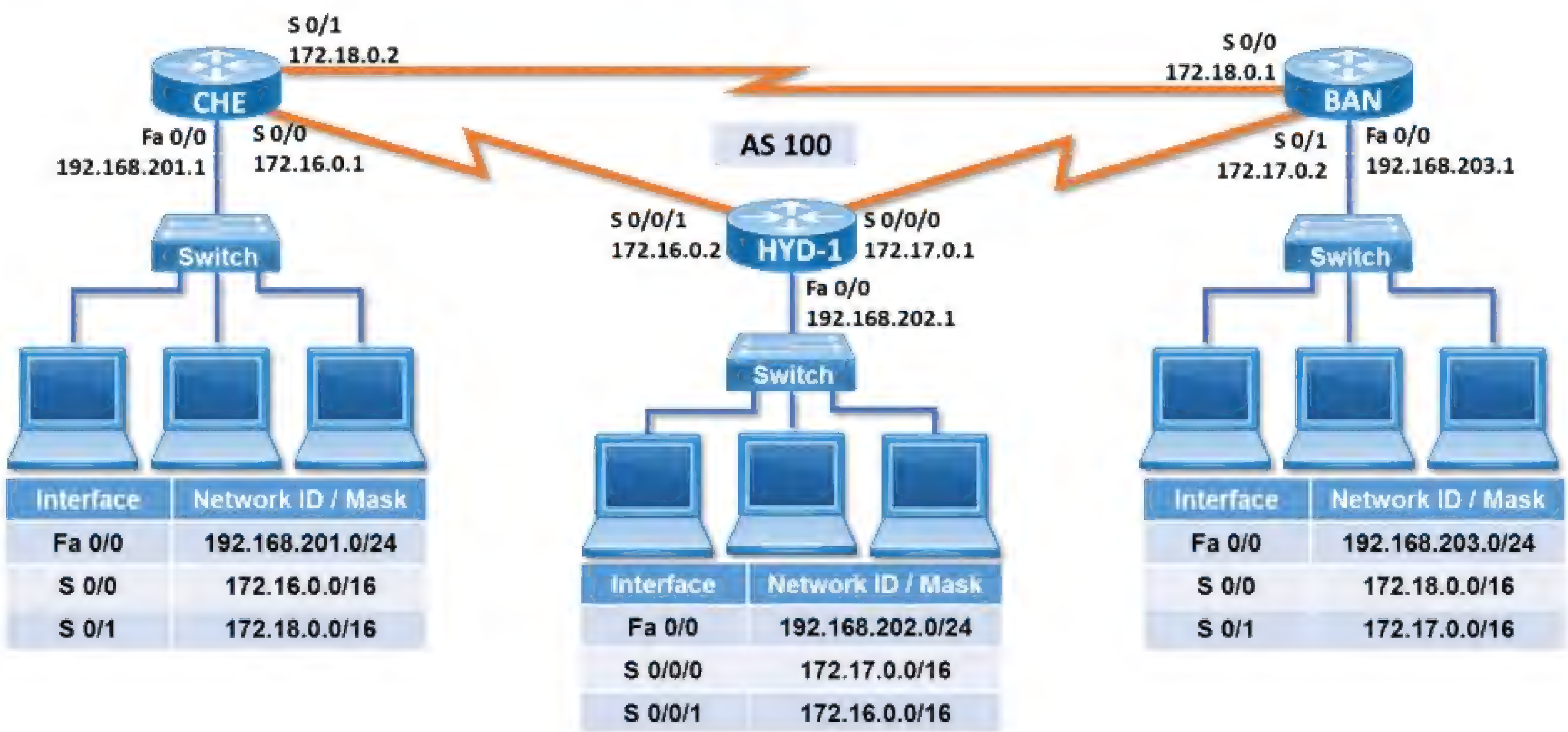
OBJECTIVE:

To configure EIGRP for communicating between different IPv4 networks on different routers.

To understand how EIGRP works and fine tune EIGRP configuration.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	172.16.0.0/16
S 0/1	172.18.0.0/16

Interface	Network ID / Mask
Fa 0/0	192.168.202.0/24
S 0/0/0	172.17.0.0/16
S 0/0/1	172.16.0.0/16

Interface	Network ID / Mask
Fa 0/0	192.168.203.0/24
S 0/0	172.18.0.0/16
S 0/1	172.17.0.0/16

Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)

TASK:

- Configure EIGRP Routing on IPv4 network
- Verify EIGRP Routing on IPv4 network
- Verify Communication between the IPv4 networks
- Verify EIGRP Neighbour and Topology Table on IPv4 networks
- Verify EIGRP protocol default settings
- Verify EIGRP Packets
- Enable Passive Interface on EIGRP
- Verify interfaces configured for EIGRP

Configure EIGRP Routing on IPv4 network

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip routing**
CHE (config) # **router eigrp 100**
CHE (config-router) # **network 192.168.201.0 0.0.0.255**
CHE (config-router) # **network 172.16.0.0 0.0.255.255**
CHE (config-router) # **network 172.18.0.0 0.0.255.255**
CHE (config-router) # **end**
CHE #

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip routing**
HYD-1 (config) # **router eigrp 100**
HYD-1 (config-router) # **network 192.168.202.0 0.0.0.255**
HYD-1 (config-router) # **network 172.16.0.0 0.0.255.255**
HYD-1 (config-router) # **network 172.17.0.0 0.0.255.255**
HYD-1 (config-router) # **end**
HYD-1 #

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # **ip routing**
BAN (config) # **router eigrp 100**
BAN (config-router) # **network 192.168.203.0 0.0.0.255**
BAN (config-router) # **network 172.17.0.0 0.0.255.255**
BAN (config-router) # **network 172.18.0.0 0.0.255.255**
BAN (config-router) # **end**
BAN #

Verify EIGRP Routing

Once EIGRP routing is enabled, IPv4 Networks learnt via **EIGRP** are added into the routing table. **"D"** represents **EIGRP route.**

CHE – Verification:

```
CHE # show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

D    172.17.0.0/16 [90/2681856] via 172.16.0.2, 00:02:18, Serial0/0
                   [90/2681856] via 172.18.0.1, 00:02:18, Serial0/1
C    172.16.0.0/16 is directly connected, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/1
C    192.168.201.0/24 is directly connected, FastEthernet0/0
D    192.168.202.0/24 [90/2172416] via 172.16.0.2, 00:02:18, Serial0/0
D    192.168.203.0/24 [90/2172416] via 172.18.0.1, 00:02:18, Serial0/1
CHE #
```

HYD-1 – Verification:

```
HYD-1 # show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       E1 - OSPF external type 1, E2 - OSPF external type 2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/16 is directly connected, Serial0/0/1
L       172.16.0.2/32 is directly connected, Serial0/0/1
     172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.17.0.0/16 is directly connected, Serial0/0/0
L       172.17.0.1/32 is directly connected, Serial0/0/0
D    172.18.0.0/16 [90/2681856] via 172.17.0.2, 00:02:53, Serial0/0/0
                   [90/2681856] via 172.16.0.1, 00:02:53, Serial0/0/1
D    192.168.201.0/24 [90/2172416] via 172.16.0.1, 00:02:48, Serial0/0/1
     192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.202.0/24 is directly connected, FastEthernet0/0
L       192.168.202.1/32 is directly connected, FastEthernet0/0
D    192.168.203.0/24 [90/2172416] via 172.17.0.2, 00:02:50, Serial0/0/0
HYD-1#
```

BAN – Verification:

```
BAN # show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    172.17.0.0/16 is directly connected, Serial0/1
D    172.16.0.0/16 [90/2681856] via 172.17.0.1, 00:03:17, Serial0/1
                   [90/2681856] via 172.18.0.2, 00:03:17, Serial0/0
C    172.18.0.0/16 is directly connected, Serial0/0
D    192.168.201.0/24 [90/2172416] via 172.18.0.2, 00:03:17, Serial0/0
D    192.168.202.0/24 [90/2172416] via 172.17.0.1, 00:03:17, Serial0/1
C    192.168.203.0/24 is directly connected, FastEthernet0/0
BAN#
```

Verify communication between the IPv4 networks

Verification from a Computer in HYD-1 Network

ping 192.168.201.10

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms
```

ping 192.168.203.10

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

Repeat the above ping verification from a computer in CHE and BAN Network.

From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

Repeat the above trace communication path from a computer in CHE and BAN Network.

Verify EIGRP Neighbour and Topology Table on IPv4 Network

CHE – Verification:

CHE # **show ip eigrp neighbor**

IP-EIGRP neighbors for process 100

H	Address	Interface (sec)	Hold (ms)	Uptime	SRTT	RTO Cnt	Q Num	Seq	Type
1	172.18.0.1	Se0/1	13	00:02:22	28	200	0	6	
0	172.16.0.2	Se0/0	11	00:03:29	27	200	0	10	

CHE#

CHE # **show ip eigrp topology**

IP-EIGRP Topology Table for AS(10)/ID(192.168.201.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
    r - Reply status
P 192.168.201.0/24, 1 successors, FD is 281600
    via Connected, FastEthernet0/0
P 192.168.202.0/24, 1 successors, FD is 2172416
    via 172.16.0.2 (2172416/28160), Serial0/0
P 192.168.203.0/24, 1 successors, FD is 2172416
    via 172.18.0.1 (2172416/28160), Serial0/1
P 172.16.0.0/16, 1 successors, FD is 2169856
    via Connected, Serial0/0
P 172.17.0.0/16, 2 successors, FD is 2681856
    via 172.18.0.1 (2681856/2169856), Serial0/1
    via 172.16.0.2 (2681856/2169856), Serial0/0
P 172.18.0.0/16, 1 successors, FD is 2169856
    via Connected, Serial0/1
CHE#

HYD-1 – Verification:

HYD-1 # **show ip eigrp neighbor**
EIGRP-IPv4 Neighbors for AS(100)

H	Address	Interface	Hold (sec)	Uptime	SRTT (ms)	RTO	Q Cnt	Seq Num	Type
1	172.16.0.1	Se0/0/1	13	01:06:11	28	200	0	7	
0	172.17.0.2	Se0/0/0	14	01:09:47	26	200	0	10	

HYD-1#

HYD-1 # **show ip eigrp topology**
EIGRP-IPv4 Topology Table for AS(100)/ID(192.168.202.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
r - reply Status, s - sia Status

```
P 192.168.203.0/24, 1 successors, FD is 2172416
      via 172.17.0.2 (2172416/28160), Serial0/0/0
P 172.16.0.0/16, 1 successors, FD is 2169856
      via Connected, Serial0/0/1
P 172.18.0.0/16, 2 successors, FD is 2681856
      via 172.16.0.1 (2681856/2169856), Serial0/0/1
      via 172.17.0.2 (2681856/2169856), Serial0/0/0
P 172.17.0.0/16, 1 successors, FD is 2169856
      via Connected, Serial0/0/0
P 192.168.201.0/24, 1 successors, FD is 2195456
      via 172.16.0.1 (2195456/281600), Serial0/0/1
P 192.168.202.0/24, 1 successors, FD is 28160
      via Connected, FastEthernet0/0
HYD-1#
```

BAN – Verification:

BAN # **show ip eigrp neighbor**
IP-EIGRP neighbors for process 100

H	Address	Interface	Hold (sec)	Uptime	SRTT (ms)	RTO	Q Cnt	Seq Num	Type
1	172.17.0.1	Se0/1	13	00:00:53	69	200	0	11	
0	172.18.0.2	Se0/0	13	00:01:02	411	2466	0	12	

BAN#

BAN # **show ip eigrp topology**
IP-EIGRP Topology Table for AS(100)/ID(192.168.203.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
r - reply Status, s - sia Status

```
P 192.168.201.0/24, 1 successors, FD is 2195456
      via 172.18.0.2 (2172416/28160), Serial0/0
P 192.168.202.0/24, 1 successors, FD is 2172416
      via 172.17.0.1 (2172416/28160), Serial0/1
```

```
P 192.168.203.0/24, 1 successors, FD is 28160
        via Connected, FastEthernet0/0
P 172.16.0.0/16, 2 successors, FD is 2681856
        via 172.18.0.2 (2681856/2169856), Serial0/0
        via 172.17.0.1 (2681856/2169856), Serial0/1
P 172.17.0.0/16, 1 successors, FD is 2169856
        via Connected, Serial0/1
P 172.18.0.0/16, 1 successors, FD is 2169856
        via Connected, Serial0/0
BAN#
```

Verify EIGRP protocol default settings

Example - HYD-1

```
HYD-1 # show ip protocols
Routing Protocol is "eigrp 100"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP-IPv4 Protocol for AS(100)
    Metric weight K1=1, K2=0, K3=1, K4=0, K5=0
    NSF-aware route hold timer is 240
    Router-ID: 192.168.202.1
    Topology : 0 (base)
      Active Timer: 3 min
      Distance: internal 90 external 170
      Maximum path: 4
      Maximum hopcount 100
      Maximum metric variance 1
  Automatic Summarization: Enabled
  Maximum path: 4
  Routing for Networks:
    172.16.0.0
    172.17.0.0
    192.168.202.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    172.16.0.1            90      00:00:41
    172.17.0.2            90      00:00:41
  Distance: internal 90 external 170
R2#
```

Verify EIGRP Packets

Verify default behaviour of EIGRP Hello / Update packets by enabling debug commands

Example - HYD-1

HYD-1 # **terminal monitor**
HYD-1 # **debug eigrp packet**

(UPDATE, REQUEST, QUERY, REPLY, HELLO, IPXSAP, PROBE, ACK, STUB, SIAQUERY, SIAREPLY)

EIGRP Packet debugging is on
*Jul 21 17:57:04.245: EIGRP: Packet from ourselves ignored
*Jul 21 17:57:04.861: EIGRP: Sending HELLO on Serial0/0/0
*Jul 21 17:57:04.861: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0
*Jul 21 17:57:04.909: EIGRP: Sending HELLO on Serial0/0/1
*Jul 21 17:57:04.909: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0
*Jul 21 17:57:04.917: EIGRP: Received HELLO on Serial0/0/1 nbr 172.16.0.1
*Jul 21 17:57:04.917: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Jul 21 17:57:05.621: EIGRP: Received HELLO on Serial0/0/0 nbr 172.17.0.2
*Jul 21 17:57:05.621: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Jul 21 17:57:05.793: EIGRP: Received HELLO on FastEthernet0/0 nbr 192.168.203.1
*Jul 21 17:57:05.793: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 21 17:57:05.793: EIGRP-IPv4(10): Neighbor 192.168.203.1 not on common subnet for GigabitEthernet0/0
*Jul 21 17:57:06.949: EIGRP: Received HELLO on FastEthernet0/0 nbr 192.168.202.1
*Jul 21 17:57:06.949: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 21 17:57:07.317: EIGRP: Sending HELLO on Loopback1
*Jul 21 17:57:07.317: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0
*Jul 21 17:57:07.317: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
*Jul 21 17:57:07.317: EIGRP: Packet from ourselves ignored
*Jul 21 17:57:07.409: EIGRP: Sending HELLO on FastEthernet0/0
*Jul 21 17:57:07.409: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0
!
<output omitted>
!
*Jul 21 17:57:12.109: EIGRP: Packet from ourselves ignored
*Jul 21 17:57:12.201: EIGRP: Sending HELLO on FastEthernet0/0
*Jul 21 17:57:12.201: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ un/rely 0/0

HYD-1 # **undebug all**
HYD-1 # **terminal no monitor**

Enabling Passive Interface on EIGRP

To disable sending of EIGRP hello / updates packet on selected Interface. (i.e. Ethernet Interface) we use the passive interface command.

Example - HYD-1

HYD-1# **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **router eigrp 100**
HYD-1 (config-router) # **passive-interface FastEthernet0/0**
HYD-1 (config-router) # **end**

HYD-1 – Verification:

```
HYD-1 # show ip protocols
Routing Protocol is "eigrp 100"
 Outgoing update filter list for all interfaces is not set
 Incoming update filter list for all interfaces is not set
 EIGRP-IPv4 Protocol for AS(100)
  Metric weight K1=1, K2=0, K3=1, K4=0, K5=0
  NSF-aware route hold timer is 240
  Router-ID: 192.168.202.1
  Topology : 0 (base)
   Distance: internal 90 external 170
   Maximum path: 4
   Maximum hopcount 100
   Maximum metric variance 1
 Automatic Summarization: Enabled
 Maximum path: 4
 Routing for Networks:
  172.16.0.0
  172.17.0.0
  192.168.202.0
 Passive Interface(s):
  FastEthernet0/0
 Routing Information Sources:
  Gateway        Distance      Last Update
  172.16.0.1         90      00:00:41
  172.17.0.2         90      00:00:41
 Distance: internal 90 external 170
R2#
```

After enabling passive interface, again verify the behaviour of EIGRP Hello / Update packets by enabling debug commands. Now you will not see the following line in the debug outputs.

EIGRP: Sending HELLO on FastEthernet0/0

This means you have successfully disabled sending of EIGRP hello / updates packet on selected Interface.

Configuring Router ID

Example - HYD-1

HYD-1# **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **router eigrp 100**
HYD-1 (config-router) # **eigrp router-id 2.2.2.2**
HYD-1 (config-router) # **end**

HYD-1 – Verification:

HYD-1 # **show ip eigrp topology**
EIGRP-IPv4 Topology Table for AS(100)/ID(2.2.2.2)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
 r - reply Status, s - sia Status

P 192.168.203.0/24, 1 successors, FD is 2172416
 via 172.17.0.2 (2172416/28160), Serial0/0/0
P 172.16.0.0/16, 1 successors, FD is 2169856
 via Connected, Serial0/0/1
P 172.18.0.0/16, 2 successors, FD is 2681856
 via 172.16.0.1 (2681856/2169856), Serial0/0/1
 via 172.17.0.2 (2681856/2169856), Serial0/0/0
P 172.17.0.0/16, 1 successors, FD is 2169856
 via Connected, Serial0/0/0
P 192.168.201.0/24, 1 successors, FD is 2195456
 via 172.16.0.1 (2195456/281600), Serial0/0/1
P 192.168.202.0/24, 1 successors, FD is 28160
 via Connected, FastEthernet0/0
HYD-1#

Verify interfaces configured for EIGRP

HYD-1 # **show ip eigrp interfaces**

EIGRP-IPv4 Interfaces for AS(100)

Interface	Peers	Xmit Queue Un/Reliable	Mean SRTT	Pacing Time Un/Reliable	Multicast Flow Timer	Pending Routes
Se0/0/1	1	0/0	487	0/15	2431	0
Se0/0/0	1	0/0	32	0/15	155	0
Fa0/0	0	0/0	0	0/1	0	0

HYD-1 #

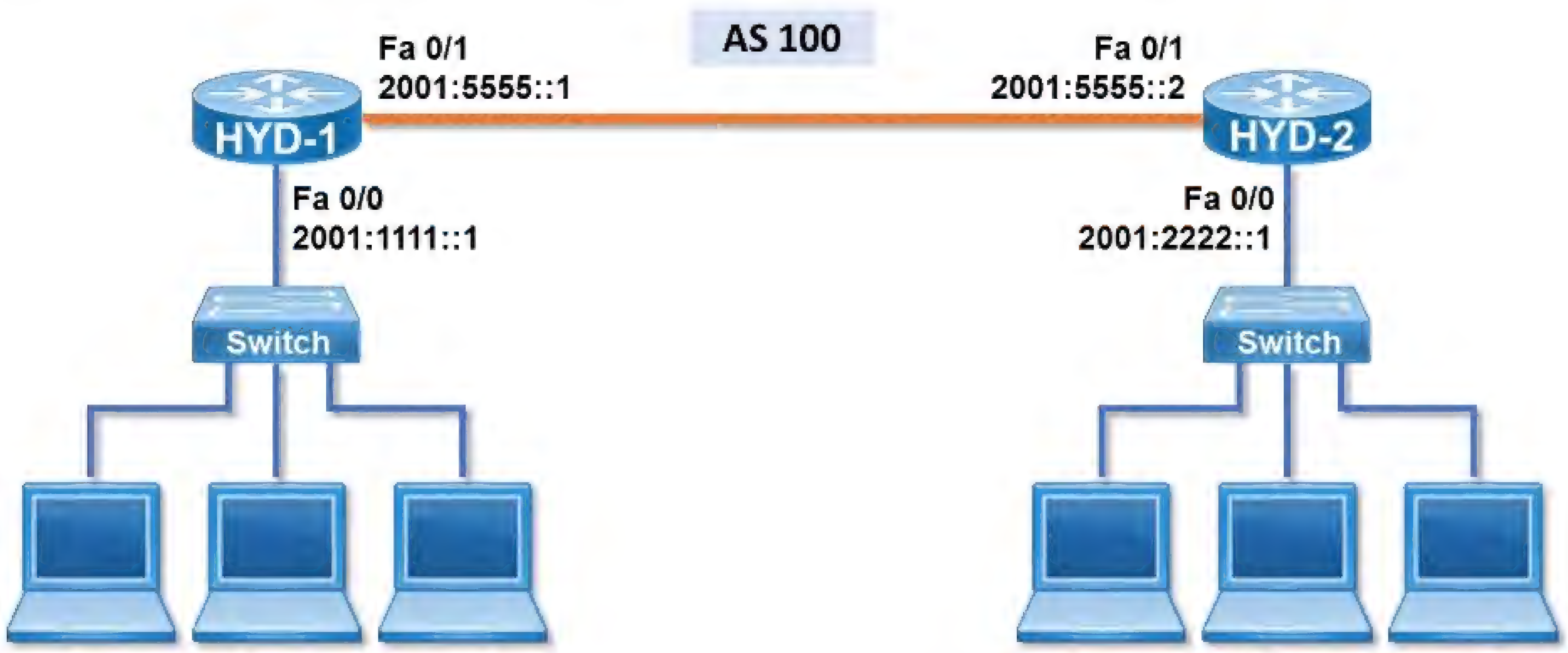
LAB 16: EIGRPv6 ON IPv6 NETWORK

OBJECTIVE:

To configure EIGRPv6 routing for communicating between different IPv6 networks on different routers.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	2001:1111::/64
Fa 0/1	2001:5555::/64

Interface	Network ID / Mask
Fa 0/0	2001:2222::/64
Fa 0/1	2001:5555::/64

Pre-requisite: WAN Interface configuration to be done on the router (LAB – 7)

TASK:

- Configure EIGRPv6 on IPv6 Network
- Verify EIGRPv6 on IPv6 Network
- Verify Communication between the IPv6 networks
- Verify EIGRP Neighbour and Topology Table on IPv6 networks

Configure EIGRPv6 on IPv6 Network

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ipv6 unicast-routing**
HYD-1 (config) # **ipv6 router eigrp 100**
HYD-1 (config-rtr) # **eigrp router-id 11.11.11.11**
HYD-1 (config-rtr) # **exit**
HYD-1 (config) # **interface fastethernet 0/0**
HYD-1 (config-if) # **ipv6 eigrp 100**
HYD-1 (config-if) # **exit**
HYD-1 (config) # **interface fastethernet 0/1**
HYD-1 (config-if) # **ipv6 eigrp 100**
HYD-1 (config-if) # **end**
HYD-1 #

HYD-2 – Configuration

HYD-2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-2 (config) # **ipv6 unicast-routing**
HYD-2 (config) # **ipv6 router eigrp 100**
HYD-2 (config-rtr) # **eigrp router-id 22.22.22.22**
HYD-2 (config-rtr) # **exit**
HYD-2 (config) # **interface fastethernet 0/0**
HYD-2 (config-if) # **ipv6 eigrp 100**
HYD-2 (config-if) # **exit**
HYD-2 (config) # **interface fastethernet 0/1**
HYD-2 (config-if) # **ipv6 eigrp 100**
HYD-2 (config-if) # **end**
HYD-2 #

Verify EIGRPv6 on IPv6 Network

Once EIGRP routing is enabled, IPv6 Networks learnt via **EIGRP** are added into the routing table. **"D"** represents **EIGRP route.**

HYD-1 – Verification:

```
HYD-1 # show ip route
IPv6 Routing Table - default - 6 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
C  2001:1111::/64 [0/0]
    via FastEthernet0/0, directly connected
L  2001:1111::1/128 [0/0]
    via FastEthernet0/0, receive
D  2001:2222::/64 [90/30720]
    via FE80::21C:F6FF:FE85:1FA1, FastEthernet0/1
C  2001:5555::/64 [0/0]
    via FastEthernet0/1, directly connected
L  2001:5555::1/128 [0/0]
    via FastEthernet0/1, receive
L  FF00::/8 [0/0]
    via Null0, receive
HYD-1 #
```

HYD-2 – Verification:

```
HYD-2 # show ipv6 route
IPv6 Routing Table - default - 6 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D  2001:1111::/64 [90/30720]
    via FE80::21B:2AFF:FEA4:2FE9, FastEthernet0/1
C  2001:2222::/64 [0/0]
    via FastEthernet0/0, directly connected
L  2001:2222::1/128 [0/0]
    via FastEthernet0/0, receive
C  2001:5555::/64 [0/0]
    via FastEthernet0/1, directly connected
L  2001:5555::2/128 [0/0]
    via FastEthernet0/1, receive
L  FF00::/8 [0/0]
    via Null0, receive
HYD-2#
```

Verify communication between the IPv6 networks

Verification from a Computer in HYD-1 Network

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms

Verification from a Computer in HYD-2 Network

ping 2001:1111::10 (Windows) or ping6 2001:1111::10 (Linux)

PING 2001:1111::10(2001:1111::10) 56 data bytes
64 bytes from 2001:1111::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:1111::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:1111::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:1111::10: icmp_seq=4 ttl=62 time=0.336 ms

From a Computer in HYD-1 Network trace communication path to a Computer in HYD-2 Network

`tracert 2001:2222::10 (Windows) or traceroute6 2001:2222::10 (Linux)`

```
traceroute to 2001:2222::10 (2001:2222::10), 30 hops max, 80 byte packets
 1  2001:1111::1 (2001:1111::1)  2.825 ms  3.239 ms  3.665 ms
 2  2001:5555::2 (2001:5555::2)  9.086 ms  9.393 ms  9.642 ms
 3  2001:2222::10 (2001:2222::10)  9.781 ms  10.474 ms  10.720 ms
```

From a Computer in HYD-2 Network trace communication path to a Computer in HYD-1 Network

`tracert 2001:1111::10 (Windows) or traceroute6 2001:1111::10 (Linux)`

```
traceroute to 2001:1111::10 (2001:1111::10), 30 hops max, 80 byte packets
 1  2001:2222::1 (2001:2222::1)  1.071 ms  1.152 ms  1.238 ms
 2  2001:5555::1 (2001:5555::1)  4.303 ms  4.930 ms  5.419 ms
 3  2001:1111::10 (2001:1111::10)  10.832 ms  11.444 ms  11.541 ms
```

Verify EIGRP Neighbour and Topology Table on IPv6 Network

HYD-1 – Verification:

HYD-1 # **show ip eigrp neighbour**

EIGRP-IPv6 Neighbors for AS(100)

H	Address	Interface	Hold (sec)	Uptime	SRTT (ms)	RTO	Q Cnt	Seq Num	Type
0	Link-local address: FE80::21C:F6FF:FE85:1FA1	Fa0/1	13	00:07:01	7	200	0	6	

HYD-1 #

HYD-1 # **show ipv6 eigrp topology**

EIGRP-IPv6 Topology Table for AS(100)/ID(11.11.11.11)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
r - reply Status, s - sia Status

P 2001:2222::/64, 2 successors, FD is 30720
via FE80::21C:F6FF:FE85:1FA1 (30720/28160), FastEthernet0/1
P 2001:1111::/64, 1 successors, FD is 28160
via Connected, FastEthernet0/0
P 2001:5555::/64, 1 successors, FD is 28160
via Connected, FastEthernet0/1
HYD-1 #

HYD-2 – Verification:

HYD-2 # **show ip eigrp neighbors**

EIGRP-IPv6 Neighbors for AS(100)

H	Address	Interface	Hold (sec)	Uptime	SRTT (ms)	RTO	Q Cnt	Seq Num	Type
0	Link-local address: FE80::21B:2AFF:FEA4:2FE9	Fa0/1	13	00:07:01	7	200	0	6	

HYD-1 #

HYD-2 # **show ipv6 eigrp topology**

EIGRP-IPv6 Topology Table for AS(100)/ID(22.22.22.22)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
r - reply Status, s - sia Status
P 2001:2222::/64, 1 successors, FD is 28160
via Connected, FastEthernet0/0
P 2001:1111::/64, 2 successors, FD is 30720
via FE80::21B:2AFF:FEA4:2FE9 (30720/28160), FastEthernet0/1
P 2001:5555::/64, 1 successors, FD is 28160
via Connected, FastEthernet0/1
HYD-2 #

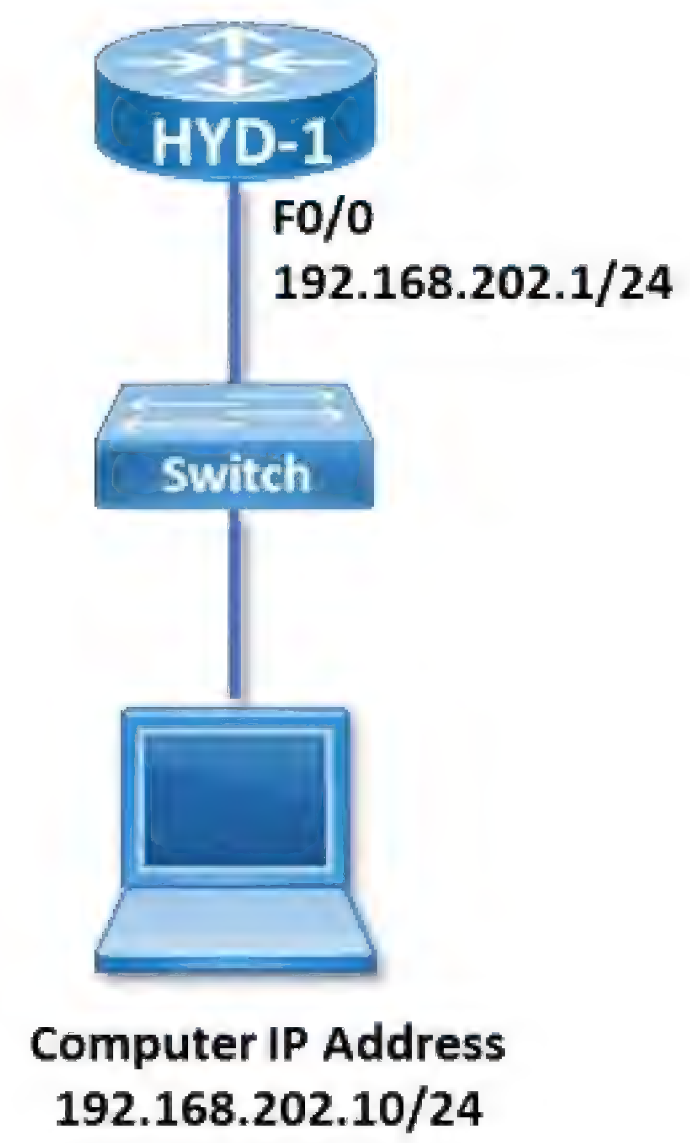
LAB 17: SYSLOG

OBJECTIVE:

To configure Logging on router and sending logs to a syslog server.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Pre-requisite: 192.168.202.10 computer should have Syslog server software installed and running.

TASK:

- Configure logging to Syslog Server
- Configure logging to Buffer
- Generate and Verify Syslog Messages

Configure Logging to Syslog Server

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **logging on**
HYD-1 (config) # **logging host 192.168.202.10**
HYD-1 (config) # **logging trap 7**
HYD-1 (config) # **exit**
HYD-1 #

Configure Logging to Buffer

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **logging on**
HYD-1 (config) # **logging buffered 7**
HYD-1 (config) # **exit**
HYD-1 #

Generate and Verify Syslog Messages

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **interface serial 0/0/0**
HYD-1 (config-if) # **shutdown**
HYD-1 (config-if) # **no shutdown**
HYD-1 (config-if) # **end**
HYD-1 #

HYD-1 – Verification:

HYD-1 # **show logging**
Syslog logging: enabled (0 messages dropped, 3 messages rate-limited, 0 flushes, 0 overruns)

No Active Message Discriminator.
No Inactive Message Discriminator.
Console logging: disabled
Monitor logging: level debugging, 0 messages logged, xml disabled,
filtering disabled
Buffer logging: level debugging, 7 messages logged, xml disabled,
filtering disabled
Exception Logging: size (4096 bytes)
Count and timestamp logging messages: disabled
Persistent logging: disabled

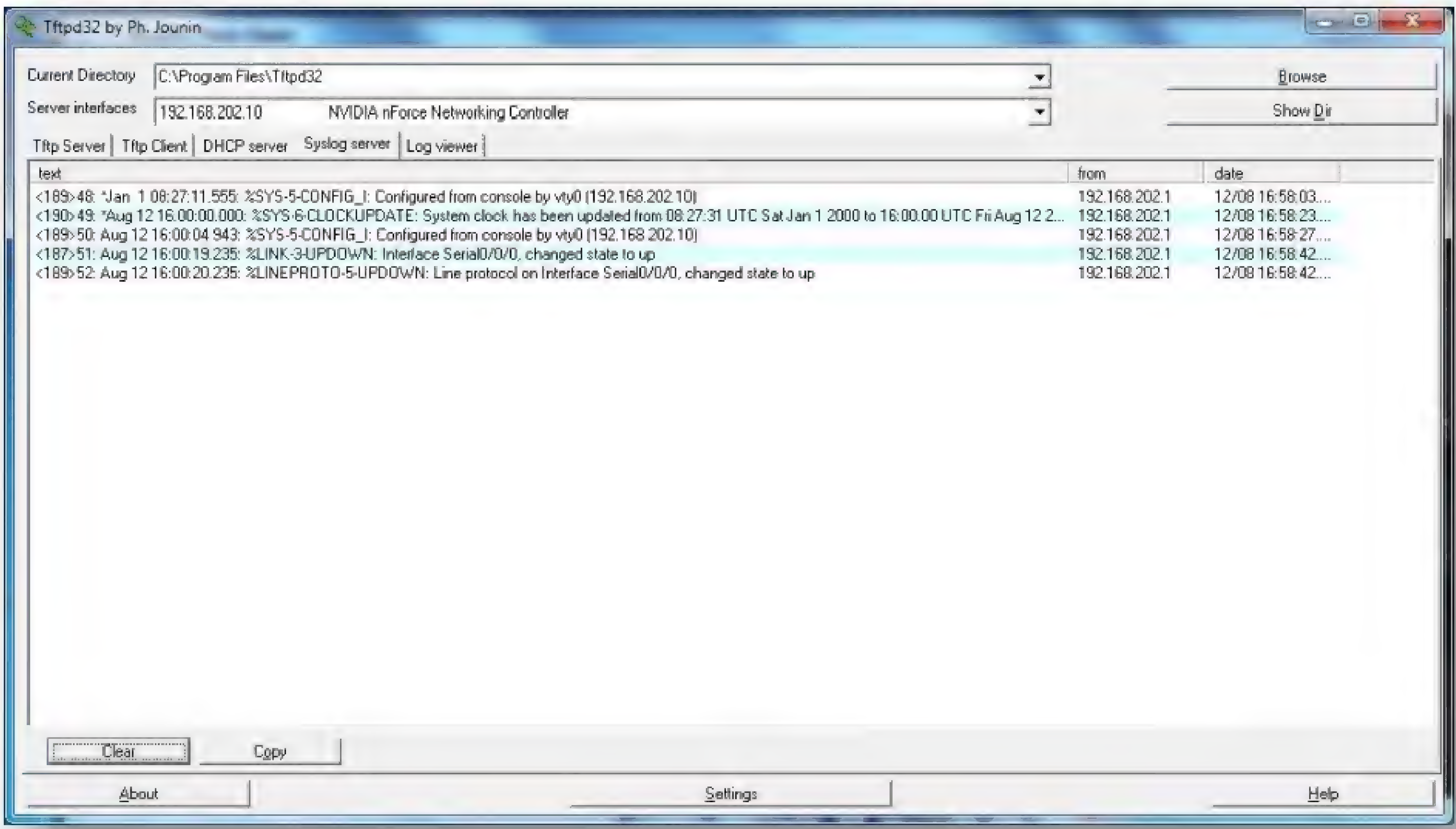
No active filter modules.
Trap logging: level informational, 45 message lines logged
Logging to 192.168.202.10 (udp port 514, audit disabled, link up),
    9 message lines logged,
    0 message lines rate-limited,
    0 message lines dropped-by-MD,
    xml disabled, sequence number disabled
    filtering disabled

Log Buffer (4096 bytes):

*Jul 28 11:51:26.447: %SYS-5-CONFIG_I: Configured from console by console
*Jul 28 11:52:11.563: %LINK-5-CHANGED: Interface Serial0/0/0, changed state to administratively down
*Jul 28 11:52:11.567: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to dn
*Jul 28 11:52:28.639: %SYS-5-CONFIG_I: Configured from console by console
*Jul 28 11:52:29.487: %LINK-3-UPDOWN: Interface Serial0/0/0, changed state to up
CHE #

Verification on Syslog Server (PC) :

Start **Syslog software** to view the syslog's messages as below :



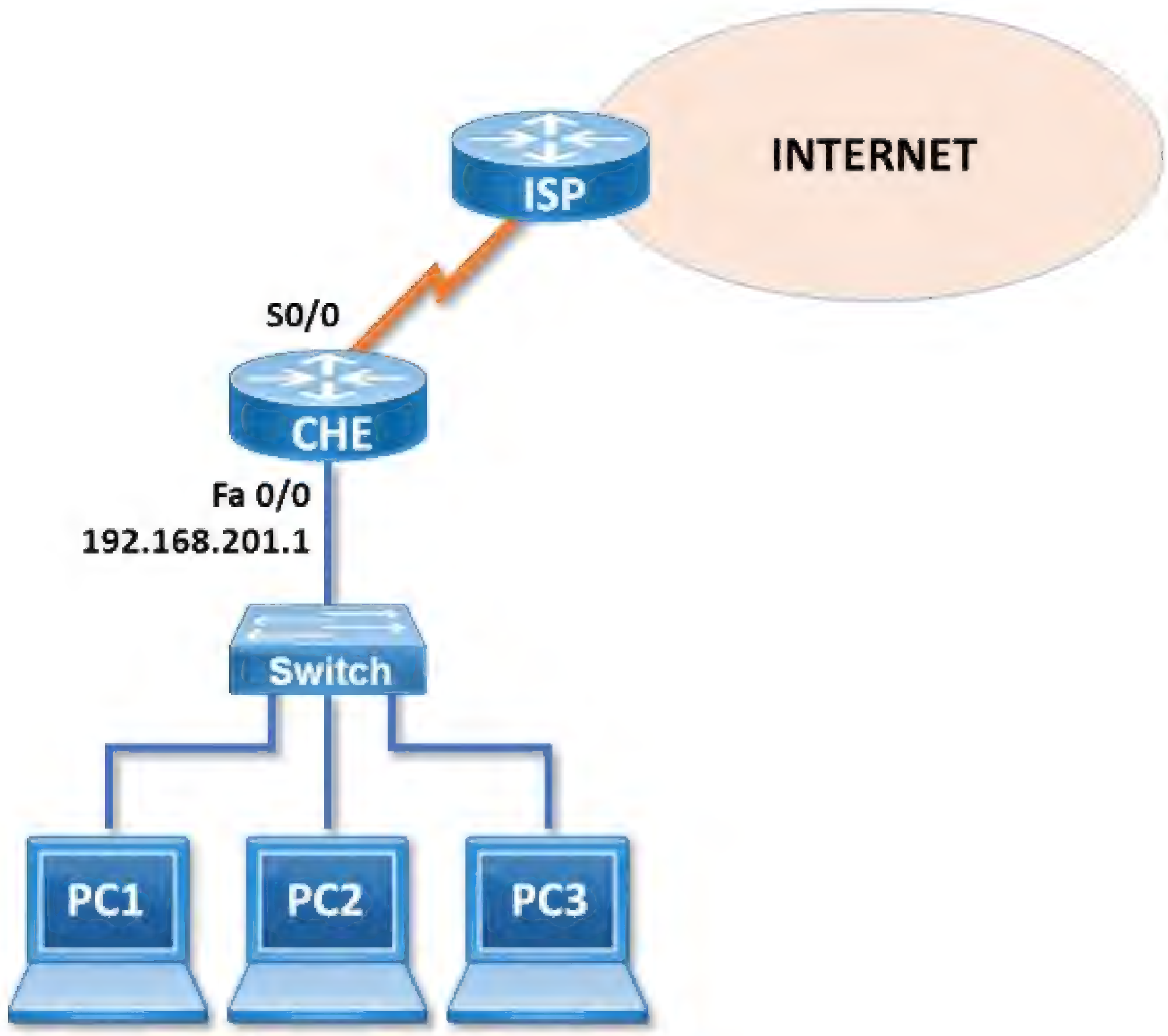
LAB 18: NTP

OBJECTIVE:

To configure router as NTP Client, for time synchronization with NTP server.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24

TASK:

- Configure Date and Time – Manual
- Verify Current Date and Time
- Configure Router as NTP client
- Verify Date and time via NTP

Configure Date and Time - Manual

CHE – Configuration

CHE # **clock set 13:36:30 10 Jan 2001**

Verify Current Date and Time

CHE – Verification:

CHE # **show clock**
13:36:32.055 UTC Wed Jan 10 2001

Configure Router as NTP client

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ntp server 8.8.8.8**
CHE (config) # **exit**
CHE #

Verify Date and time via NTP

CHE – Verification:

CHE # **show clock**
13:39:21.604 UTC Tue Aug 16 2016

CHE # **show ntp status**
Clock is synchronized, stratum 4, reference is 8.8.8.8
nominal freq is 249.5901 Hz, actual freq is 249.5901 Hz, precision is 2**18
reference time is DB5D96BC.5E7B415C (13:42:20.369 UTC Tue Aug 16 2016)
clock offset is 1.4590 msec, root delay is 32.53 msec
root dispersion is 3878.63 msec, peer dispersion is 3876.77 msec

CHE # **show ntp associations**

address	ref clock	st	when	poll	reach	delay	offset	disp
*~8.8.8.8	127.127.1.1	3	17	64	7	32.5	1.46	3876.8

* master (synced), # master (unsynced), + selected, - candidate, ~ configured
CHE #

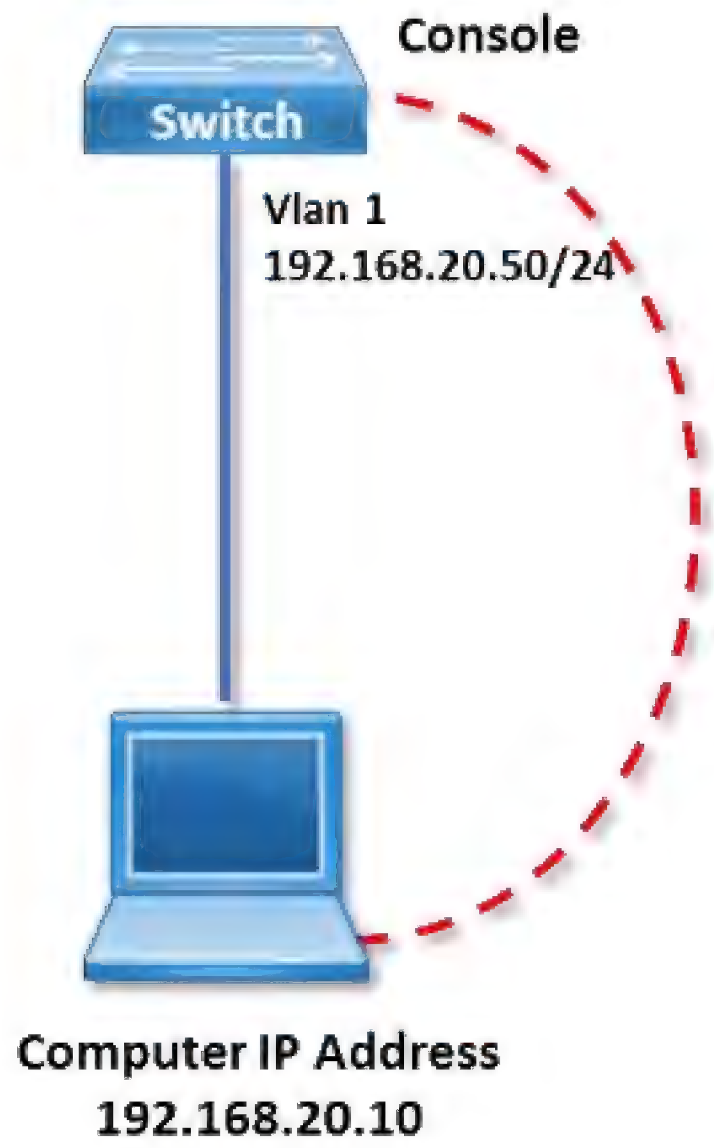
LAB 19: INITIAL CONFIGURATION OF SWITCH

OBJECTIVE:

To get familiar with Cisco Switch IOS modes and configure a New Switch with basic configuration i.e. assigning management IP address to the switch and configure passwords etc.

TOPOLOGY:

Setup console and ethernet connectivity for the lab as below :



TASK:

- Establish console connectivity
- Access switch via console with an emulation software
- Get familiar with Cisco Switch IOS Modes and Show commands
- Configure Hostname and VLAN 1 Interface IP address
- Configure Connectivity Passwords
- Configure Privilege Mode / Enable Password
- Save configuration on the switch
- Access the Switch via Telnet

Establish console connectivity

Establish console connectivity by connecting switch console port to PC Com Port with console cable.

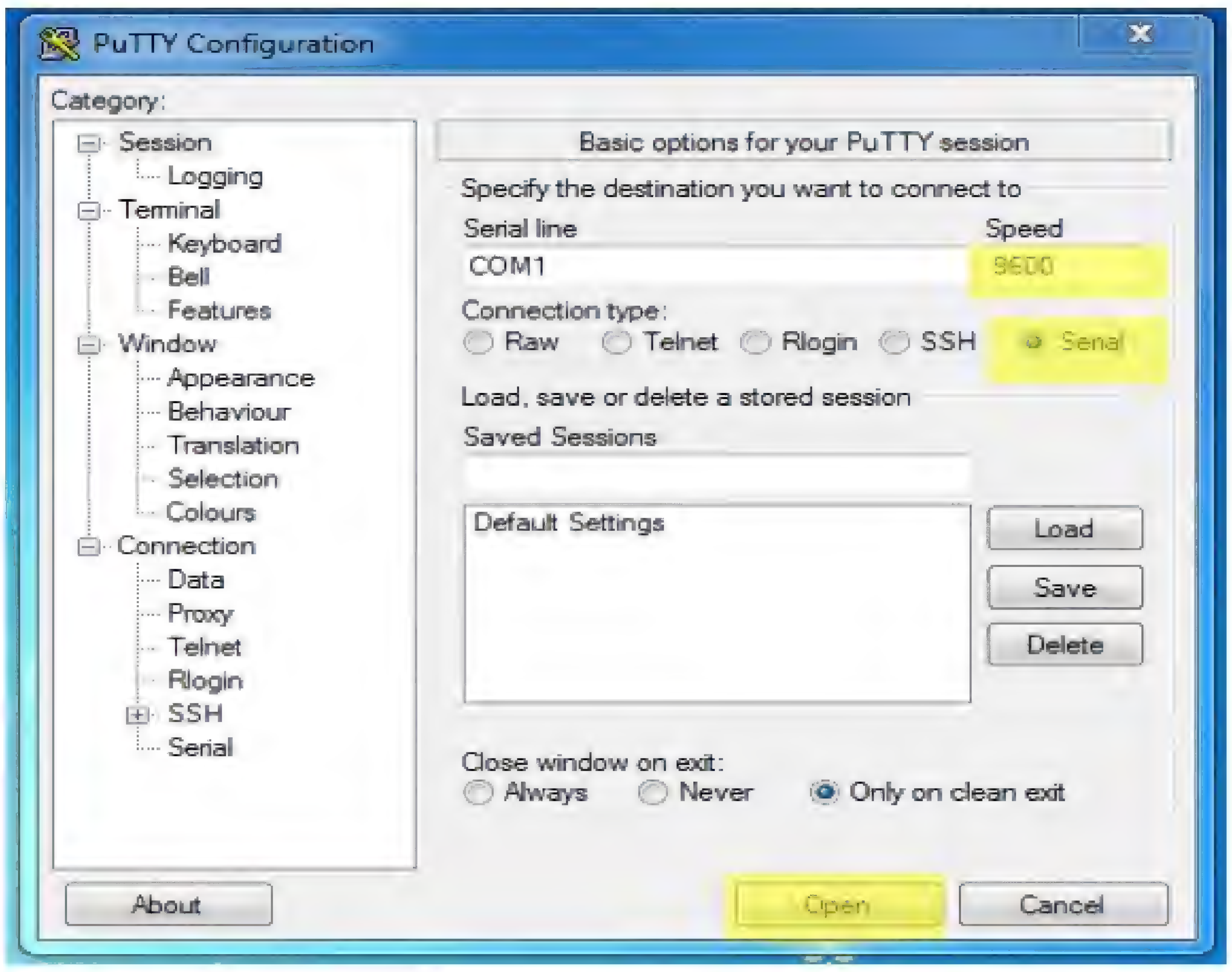
Access switch via console with an emulation software

Configure the following parameters in emulation software for accessing switch via console port.

Parameters	Console Port Settings
Baud	9600
Data bits	8
Parity	None
Stop bits	1

Accessing switch via console from Microsoft Windows Computer

- Start a terminal emulator application, such as **PUTTY.exe**
- Select **Serial** option and set speed to **9600.**
- Click **Open**



- Once emulation software is ready, **Power-ON** the switch.

Accessing switch via console from Linux Computer

- From the terminal enter the below command
  # **minicom**

- Once emulation software is ready, **Power-ON** the Switch.

Getting familiar with Cisco Switch IOS Modes and show commands

After the switch boots-up completely, (on a new Cisco Switch) it enters user mode as below:

Switch>

To navigate into Privilege mode/Executive Mode from User Mode

Switch >**enable**
Switch #

To view switch IOS and hardware information

Switch # **show version**

Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(22)EA6, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Fri 21-Oct-05 01:59 by yenanh
Image text-base: 0x80010000, data-base: 0x80568000

ROM: Bootstrap program is C2950 boot loader

Switch uptime is 4 minutes
System returned to ROM by power-on
System image file is "flash:/c2950-i6q4l2-mz.121-22.EA6.bin"

cisco WS-C2950-24 (RC32300) processor (revision G0) with 21013K bytes of memory.
Processor board ID FOC0638Z0TB
Last reset from system-reset
Running Standard Image
24 FastEthernet/IEEE 802.3 interface(s)

32K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address: 00:0A:F4:C5:94:C0
Motherboard assembly number: 73-5781-11
Power supply part number: 34-0965-01
Motherboard serial number: FOC06380AZK
Power supply serial number: DAB06347236
Model revision number: G0
Motherboard revision number: A0
Model number: WS-C2950-24
System serial number: FOC0638Z0TB
Configuration register is 0xF

Switch #

To view switch flash Information

Switch # **show flash**

```
Directory of flash:/
  1  -rwx     3110758  Mar 01 1993 08:30:59 +00:00  c2950-i6q4l2-mz.121-22.EA6.bin
  2  -rwx         564  Mar 01 1993 00:00:28 +00:00  vlan.dat

7741440 bytes total (4628480 bytes free)
Switch #
```

To view switch current configuration (RAM)

Switch # **show running-config**

```
Building configuration...

Current configuration : 1071 bytes
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Switch
!
spanning-tree mode pvst
no spanning-tree optimize bpdu transmission
spanning-tree extend system-id
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
<output omitted>
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface Vlan1
 no ip address
 no ip route-cache
 shutdown
!
ip http server
!
line con 0
line vty 5 15
!
end
Switch #
```

To view switch startup configuration (NVRAM)

Switch # **show startup-config**

startup-config is not present

To view detailed interface information (i.e. Vlan, interface status, etc.)

Switch # **show interface status**

```
Port     Name        Status      Vlan     Duplex  Speed Type
Fa0/1                connected    1        a-full  a-100 10/100BaseTX
Fa0/2                connected    1        a-full  a-100 10/100BaseTX
Fa0/3                connected    1        a-full  a-100 10/100BaseTX
Fa0/4                connected    1        a-full  a-100 10/100BaseTX
Fa0/5                connected    1        a-full  a-100 10/100BaseTX
Fa0/6                notconnect   1          auto   auto 10/100BaseTX
Fa0/7                notconnect   1          auto   auto 10/100BaseTX
Fa0/8                notconnect   1          auto   auto 10/100BaseTX
Fa0/9                notconnect   1          auto   auto 10/100BaseTX
Fa0/10               connected    1        a-half   a-10 10/100BaseTX
Fa0/11               connected    1        a-half   a-10 10/100BaseTX
Fa0/12               connected    1        a-half   a-10 10/100BaseTX
Fa0/13               connected    1        a-half   a-10 10/100BaseTX
Fa0/14               notconnect   1          auto   auto 10/100BaseTX
Fa0/15               notconnect   1          auto   auto 10/100BaseTX
Fa0/16               notconnect   1          auto   auto 10/100BaseTX
Fa0/17               notconnect   1          auto   auto 10/100BaseTX
Fa0/18               notconnect   1          auto   auto 10/100BaseTX
Fa0/19               notconnect   1          auto   auto 10/100BaseTX
Fa0/20               notconnect   1          auto   auto 10/100BaseTX
Fa0/21               notconnect   1          auto   auto 10/100BaseTX
Fa0/22               notconnect   1          auto   auto 10/100BaseTX
Fa0/23               notconnect   1          auto   auto 10/100BaseTX
Fa0/24               notconnect   1          auto   auto 10/100BaseTX
Switch #
```

To view Mac Address Table

Switch # **show mac-address-table**

```
            Mac Address Table
-------------------------------------------------
  Vlan   Mac Address        Type        Ports
-------------------------------------------------
   All   000a.f4c5.94c0     STATIC      CPU
   All   0100.0ccc.cccc     STATIC      CPU
   All   0100.0ccc.cccd     STATIC      CPU
   All   0100.0cdd.dddd     STATIC      CPU
    1    0002.4b60.d100     DYNAMIC     Fa0/13
    1    0002.fd73.7f20     DYNAMIC     Fa0/11
```

1	0010.7bb3.6f20	DYNAMIC	Fa0/12
1	001c.c012.4f54	DYNAMIC	Fa0/4
1	0030.9476.f160	DYNAMIC	Fa0/10

Total Mac Addresses for this criterion: 5
Switch #

Configure Hostname and VLAN 1 Interface IP address

To change the Host Name of Switch

Switch # **configure terminal**
Switch (config) # **hostname SW1**
SW1 (config) #

To configure IP address on Interface VLAN 1

SW1 (config) # **interface vlan 1**
SW1 (config-if) # **ip address 192.168.20.50 255.255.255.0**
SW1 (config-if) # **no shutdown**
SW1 (config-if) #**exit**

Configure Connectivity Passwords

To configure telnet password

SW1 (config) # **line vty 0 15**
SW1 (config-line) # **password zoom**
SW1 (config-line) #**login**
SW1 (config-line) #**exit**

To configure console password

SW1 (config) # **line console 0**
SW1 (config-line) # **password zoom**
SW1 (config-line) #**login**
SW1 (config-line) # **exit**

Configure Privilege Mode / Enable Password

Configure privilege password

SW1 (config) #**enable password ccna**
SW1 (config) #**enable secret zoom**

Configure Default Gateway and Description on Interface

SW1 (config) # **ip default-gateway 192.168.20.1**

SW1 (config) # **interface fastethernet 0/24**
SW1 (config-if) # **description Link to SW2**
SW1 (config-if) # **end**

Save configuration on the switch

To save configuration on switch

SW1 # **copy running-config startup-config**

Destination filename [startup-config]?
Building configuration...

[OK]
SW1 #

To view switch startup configuration (NVRAM)

SW1 # **show startup-config**

```
Building configuration...
Current configuration : 1230 bytes
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW1
!
enable secret 5 $1$HYD-1we$Mk0jdo9UpDL1T7kqcKHhk1
enable password ccna
!
ip subnet-zero
!
spanning-tree mode pvst
no spanning-tree optimize bpdu transmission
spanning-tree extend system-id
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
!
<output omitted>
```

```
!
interface FastEthernet0/23
!
interface FastEthernet0/24
 description Link to SW2
!
interface Vlan1
 ip address 192.168.20.50 255.255.255.0
 no ip route-cache
!
ip default-gateway 192.168.20.1
ip http server
!
line con 0
 password zoom
 login
line vty 0 4
 password zoom
 login
line vty 5 15
 password zoom
 login
!
!
end
```

Access the Switch via Telnet

- Access switch via telnet by giving the following command on a Windows or Linux computer.

  telnet 192.168.20.50

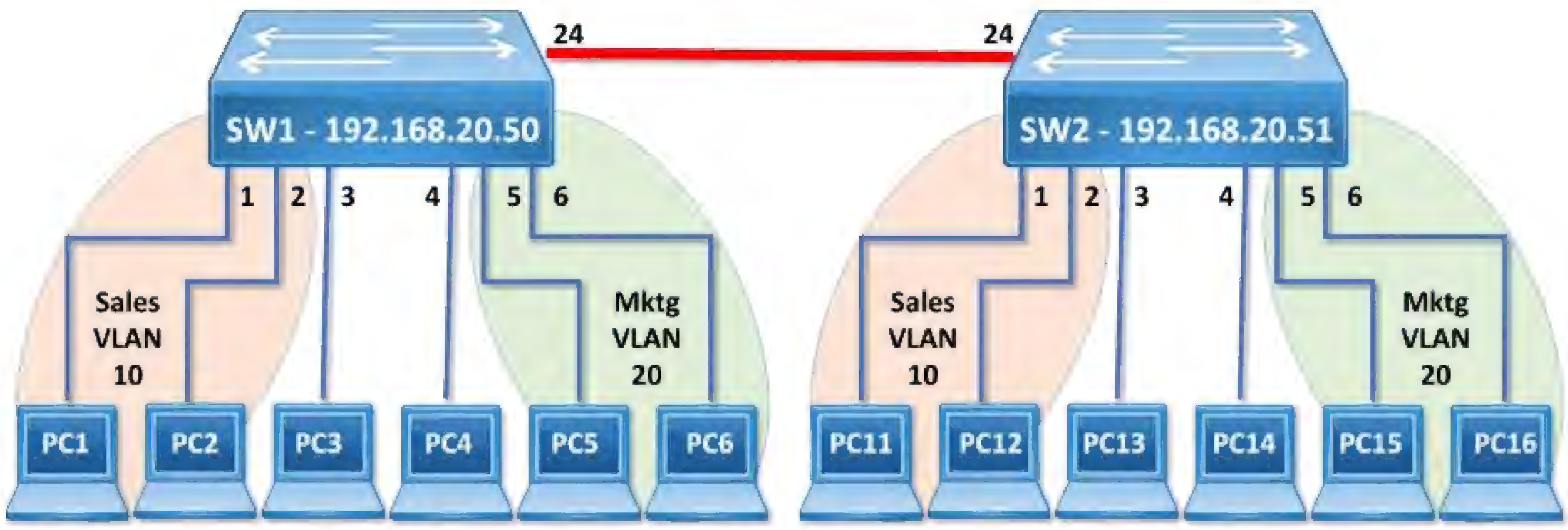
LAB 20: VLAN AND TRUNKING

OBJECTIVE:

To configure VLANs and trunking in a switched network.

TOPOLOGY:

Setup Switch and Computer connectivity for the lab as below:



TASK:

- Verify communication between the computers connected to same as well as a different switch.
- Verify Default VLAN information
- Configure and Implement VLANs
- Verify communication between the computers connected to same switch.
- Configure Trunking
- Verify communication between the computers connected to different switches.

Verify communication between the computers connected to same and different switches

From 192.168.20.1 computer (i.e. PC1) ping computers on the same switch

ping 192.168.20.2

PING 192.168.20.2 (192.168.20.2) 56(84) bytes of data.
64 bytes from 192.168.20.2: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.2: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.2: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.2: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.20.3

PING 192.168.20.3 (192.168.20.3) 56(84) bytes of data.
64 bytes from 192.168.20.3: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.3: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.3: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.3: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.20.5

PING 192.168.20.5 (192.168.20.5) 56(84) bytes of data.
64 bytes from 192.168.20.5: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.5: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.5: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.5: icmp_seq=4 ttl=62 time=24.0 ms

From 192.168.20.1 computer (i.e. PC1) ping computers on the other switch

ping 192.168.20.12

PING 192.168.20.12 (192.168.20.12) 56(84) bytes of data.
64 bytes from 192.168.20.12: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.12: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.12: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.12: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.20.13

PING 192.168.20.13 (192.168.20.13) 56(84) bytes of data.
64 bytes from 192.168.20.13: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.13: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.13: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.13: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.20.15

```
PING 192.168.20.15 (192.168.20.15) 56(84) bytes of data.
64 bytes from 192.168.20.15: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.15: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.15: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.15: icmp_seq=4 ttl=62 time=24.0 ms
```

Verify Default VLAN information

To view existing VLAN and port assigned to VLAN

SW1 – Verification:

SW1 # **show vlan brief**

```
VLAN Name               Status    Ports
---- -------------------------------- --------- -------------------------------
1    default            active    Fa0/1, Fa0/2, Fa0/3, Fa0/4, Fa0/5, Fa0/6, Fa0/7, Fa0/8, Fa0/9,
                                  Fa0/10, Fa0/11, Fa0/12, Fa0/13, Fa0/14, Fa0/15, Fa0/16, Fa0/17,
                                  Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22, Fa0/23,Fa0/24
1002 fddi-default       act/unsup
1003 trcrf-default      act/unsup
1004 fddinet-default    act/unsup
1005 trbrf-default      act/unsup
SW1 #
```

SW2 – Verification:

SW2 # **show vlan brief**

```
VLAN Name               Status    Ports
---- -------------------------------- --------- -------------------------------
1    default            active    Fa0/1, Fa0/2, Fa0/3, Fa0/4, Fa0/5, Fa0/6, Fa0/7, Fa0/8, Fa0/9,
                                  Fa0/10, Fa0/11, Fa0/12, Fa0/13, Fa0/14, Fa0/15, Fa0/16, Fa0/17,
                                  Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22, Fa0/23,Fa0/24
1002 fddi-default       act/unsup
1003 trcrf-default      act/unsup
1004 fddinet-default    act/unsup
1005 trbrf-default      act/unsup
SW2 #
```

Configure and Implement VLAN

SW1 – Configuration

SW1 #**configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1 (config) # **vlan 10**
SW1 (config-vlan) # **name SALES**
SW1 (config-vlan) #**exit**
SW1 (config) # **vlan 20**
SW1 (config-vlan) # **name MKTG**
SW1 (config-vlan) #**exit**
SW1 (config) #

SW1 (config) # **interface range fastethernet 0/1 -2**
SW1 (config-if-range) # **switchport mode access**
SW1 (config-if-range) # **switchport access vlan 10**
SW1 (config-if-range) # **exit**
SW1(config) #
SW1 (config) # **interface range fastethernet 0/5 -6**
SW1 (config-if-range) # **switchport mode access**
SW1 (config-if-range) # **switchport access vlan 20**
SW1 (config-if-range) # **exit**

SW2 – Configuration

SW2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW2 (config) # **vlan 10**
SW2 (config-vlan) # **name SALES**
SW2 (config-vlan) #**exit**
SW2 (config) # **vlan 20**
SW2 (config-vlan) # **name MKTG**
SW2 (config-vlan) #**exit**
SW2 (config) #

SW2 (config) # **interface range fastethernet 0/1 -2**
SW2 (config-if-range) # **switchport mode access**
SW2 (config-if-range) # **switchport access vlan 10**
SW2 (config-if-range) # **exit**
SW2(config) #
SW2 (config) # **interface range fastethernet 0/5 -6**
SW2 (config-if-range) # **switchport mode access**
SW2 (config-if-range) # **switchport access vlan 20**
SW2 (config-if-range) # **exit**

To view existing VLAN and port assigned to VLAN

SW1 – Verification:

SW1 # **show vlan brief**

```
VLAN Name              Status    Ports
---- ------------------------------ --------- -------------------------------
1      default         active    Fa0/3, Fa0/4, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13,
                                 Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21,
                                 Fa0/22, Fa0/23, Fa0/24
10   SALES             active    Fa0/1, Fa0/2
20   MKTG              active    Fa0/5, Fa0/6
1002  fddi-default     act/unsup
1003  trcrf-default    act/unsup
1004  fddinet-default  act/unsup
1005  trbrf-default    act/unsup
SW1 #
```

SW1 # **show interface fastethernet 0/1 switchport**

```
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 10 (SALES)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Appliance trust: none

SW1 #
```

SW2 – Verification:

SW2 # **show vlan brief**

```
VLAN Name               Status    Ports
---- -------------------------------- --------- -------------------------------
1    default            active    Fa0/3, Fa0/4, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13,
                                  Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21,
                                  Fa0/22, Fa0/23, Fa0/24
10   SALES              active    Fa0/1, Fa0/2
20   MKTG               active    Fa0/5, Fa0/6
1002 fddi-default       act/unsup
1003 trcrf-default      act/unsup
1004 fddinet-default    act/unsup
1005 trbrf-default      act/unsup
SW2 #
```

SW2 # **show interface fastethernet 0/1 switchport**

```
Name: Fa0/5
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 20 (MKTG)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Appliance trust: none

SW2 #
```

Verify communication between the computers connected to same switch.

From 192.168.20.1 computer (i.e. PC1)

ping 192.168.20.2

PING 192.168.20.2 (192.168.20.2) 56(84) bytes of data.
64 bytes from 192.168.20.2: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.2: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.2: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.2: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.20.3

PING 192.168.20.3 (192.168.20.3) 56(84) bytes of data.
From 192.168.20.1 icmp_seq=1 Destination Host Unreachable
From 192.168.20.1 icmp_seq=2 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable

ping 192.168.20.5

PING 192.168.20.5 (192.168.20.5) 56(84) bytes of data.
From 192.168.20.1 icmp_seq=1 Destination Host Unreachable
From 192.168.20.1 icmp_seq=2 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable

From 192.168.20.6 computer (i.e. PC6)

ping 192.168.20.2

PING 192.168.20.2 (192.168.20.2) 56(84) bytes of data.
From 192.168.20.6 icmp_seq=1 Destination Host Unreachable
From 192.168.20.6 icmp_seq=2 Destination Host Unreachable
From 192.168.20.6 icmp_seq=3 Destination Host Unreachable
From 192.168.20.6 icmp_seq=3 Destination Host Unreachable

ping 192.168.20.5

PING 192.168.20.5 (192.168.20.5) 56(84) bytes of data.
64 bytes from 192.168.20.5: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.5: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.5: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.5: icmp_seq=4 ttl=62 time=24.0 ms

Configure Trunking

SW1 – Configuration

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1 (config)# **interface fastethernet 0/24**
SW1 (config-if)# **switchport mode trunk**
SW1 (config-if)# **switchport trunk allowed vlan all**
SW1 (config-if)# **^Z**
SW1 #

SW2 – Configuration

SW2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW2 (config)# **interface fastethernet 0/24**
SW2 (config-if)# **switchport mode trunk**
SW2 (config-if)# **switchport trunk allowed vlan all**
SW2 (config-if)# **^Z**
SW2 #

Verify trunk configuration

SW1 – Verification:

SW1 # **show interface trunk**

Port	Mode	Encapsulation	Status	Native vlan
Fa0/24	on	802.1q	trunking	1

Port	Vlans allowed on trunk
Fa0/24	1-4094

Port	Vlans allowed and active in management domain
Fa0/24	1,10,20

Port	Vlans in spanning tree forwarding state and not pruned
Fa0/24	none

SW1 #

SW1 # **show interface fastethernet 0/24 switchport**
Name: Fa0/24
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Appliance trust: none

SW1 #

SW2 – Verification:

SW2 # **show interface trunk**

Port	Mode	Encapsulation	Status	Native vlan
Fa0/24	on	802.1q	trunking	1

Port	Vlans allowed on trunk
Fa0/24	1-4094

Port	Vlans allowed and active in management domain
Fa0/24	1,10,20

Port	Vlans in spanning tree forwarding state and not pruned
Fa0/24	none

SW2 #

```
SW2 # show interface fastethernet 0/24 switchport
Name: Fa0/24
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Appliance trust: none

SW2 #
```

Verify communication between the computers connected to different switch.

From 192.168.20.1 computer (i.e. PC1)

ping 192.168.20.12

PING 192.168.20.12 (192.168.20.12) 56(84) bytes of data.
64 bytes from 192.168.20.12: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.12: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.12: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.12: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.20.13

PING 192.168.20.13 (192.168.20.13) 56(84) bytes of data.
From 192.168.20.1 icmp_seq=1 Destination Host Unreachable
From 192.168.20.1 icmp_seq=2 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable

ping 192.168.20.15

PING 192.168.20.15 (192.168.20.15) 56(84) bytes of data.
From 192.168.20.1 icmp_seq=1 Destination Host Unreachable
From 192.168.20.1 icmp_seq=2 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable

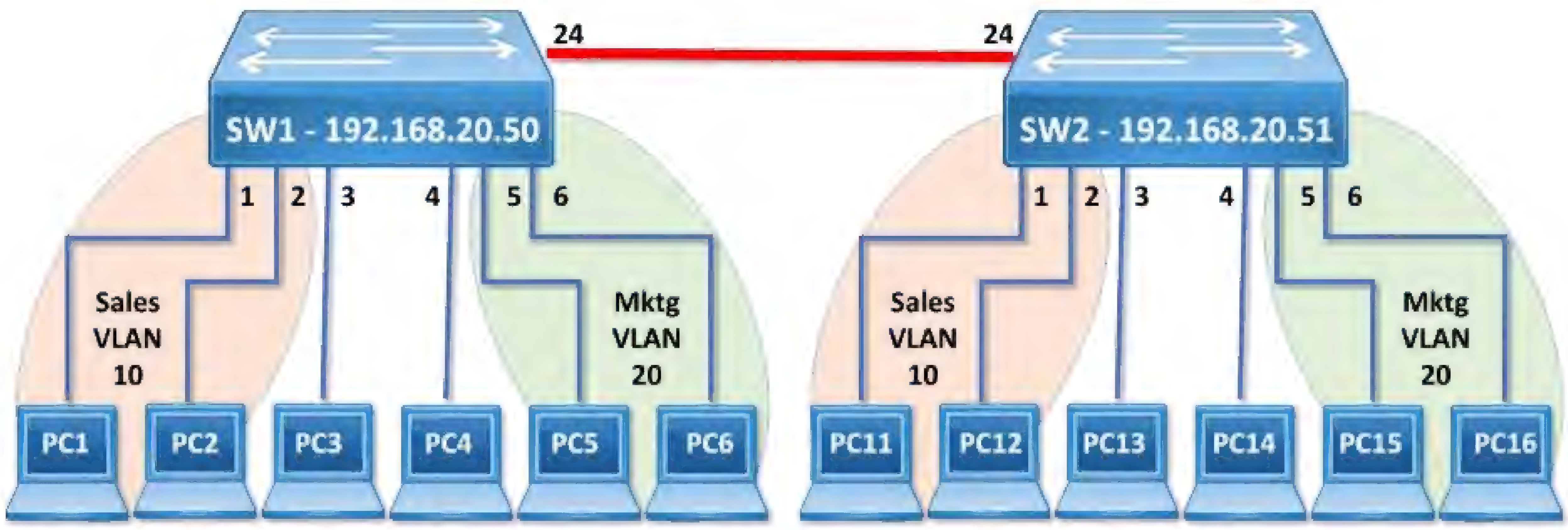
LAB 21: DYNAMIC TRUNKING PROTOCOL (DTP)

OBJECTIVE:

To configure Dynamic trunking protocol in a switched network.

TOPOLOGY:

Setup Switch and Computer connectivity for the lab as below:



Pre-requisite: VLAN and Trunking configuration to be done on the Switch (LAB – 20)

TASK:

- Configure Dynamic Trunking Protocol (DTP)
- Verify communication between the computers connected to different switches.

Configure DTP Trunking

SW1 – Configuration

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1 (config)# **interface fastethernet 0/24**
SW1 (config-if)# **switchport mode dynamic desirable**
SW1 (config-if)# **end**
SW1 #

SW2 – Configuration

SW2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW2 (config)# **interface fastethernet 0/24**
SW2 (config-if)# **switchport mode dynamic auto**
SW2 (config-if)# **end**
SW2 #

Verify DTP Trunk configuration

SW1 – Verification:

SW1 # **show interface trunk**

Port	Mode	Encapsulation	Status	Native vlan
Fa0/24	desirable	802.1q	trunking	1

Port	Vlans allowed on trunk
Fa0/24	1-4094

Port	Vlans allowed and active in management domain
Fa0/24	1,10,20

Port	Vlans in spanning tree forwarding state and not pruned
Fa0/24	none

SW1 #

SW1 # **show interface fastethernet 0/24 switchport**
Name: Fa0/24
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Appliance trust: none

SW1 #

<u>SW2 – Verification</u>:

SW2 # **show interface trunk**

Port	Mode	Encapsulation	Status	Native vlan
Fa0/24	Auto	802.1q	trunking	1

Port	Vlans allowed on trunk
Fa0/24	1-4094

Port	Vlans allowed and active in management domain
Fa0/24	1,10,20

Port	Vlans in spanning tree forwarding state and not pruned
Fa0/24	none

SW2 #

SW2 # **show interface fastethernet 0/24 switchport**
Name: Fa0/24
Switchport: Enabled
Administrative Mode: dynamic auto
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Appliance trust: none

SW2 #

Verify communication between the computers connected to different switch.

From 192.168.20.1 computer (i.e. PC1)

ping 192.168.20.12

PING 192.168.20.12 (192.168.20.12) 56(84) bytes of data.
64 bytes from 192.168.20.12: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.20.12: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.20.12: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.20.12: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.20.13

PING 192.168.20.13 (192.168.20.13) 56(84) bytes of data.
From 192.168.20.1 icmp_seq=1 Destination Host Unreachable
From 192.168.20.1 icmp_seq=2 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable

ping 192.168.20.15

PING 192.168.20.15 (192.168.20.15) 56(84) bytes of data.
From 192.168.20.1 icmp_seq=1 Destination Host Unreachable
From 192.168.20.1 icmp_seq=2 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable
From 192.168.20.1 icmp_seq=3 Destination Host Unreachable

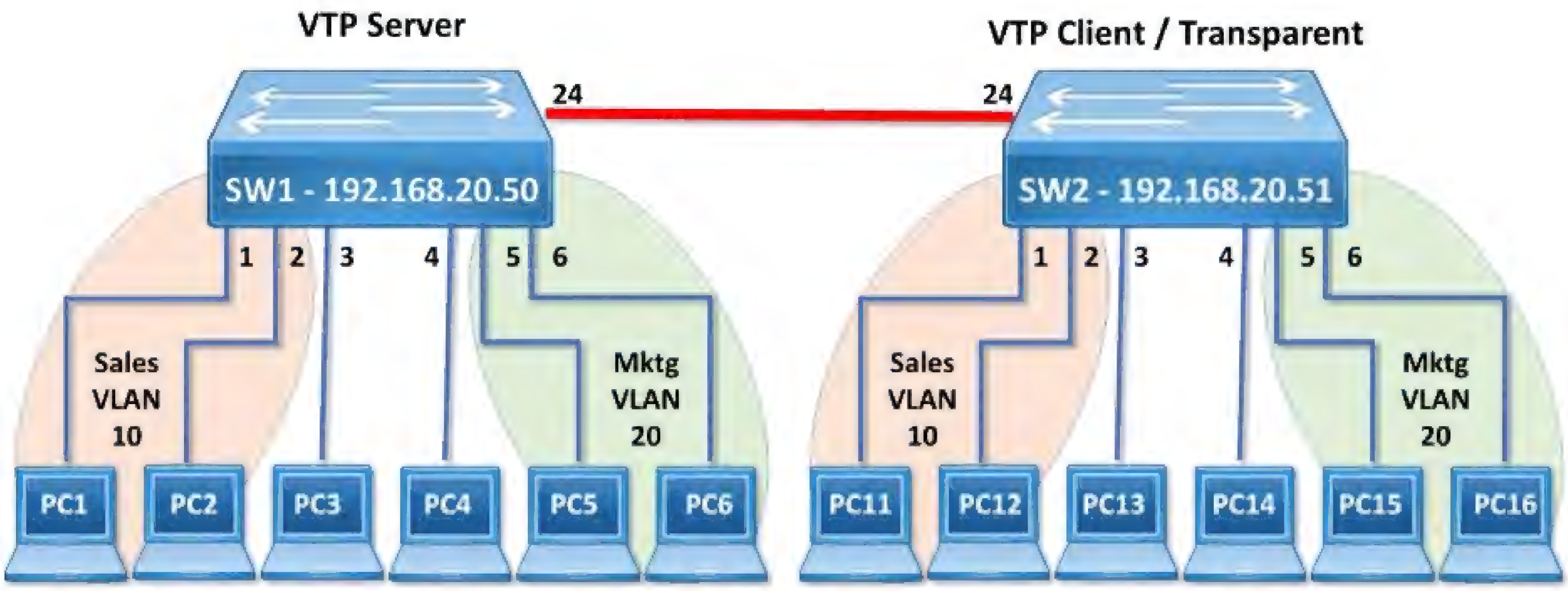
LAB 22: VLAN TRUNKING PROTOCOL (VTP)

OBJECTIVE:

To implement VTP domain name and password on switches across the network.

TOPOLOGY:

Setup Switch connectivity for the lab as below :



Pre-requisite: VLAN and Trunking configuration to be done on the Switch (LAB – 20)

TASK:

- Configure VTP domain name and password
- Verify the working of VTP

Configure VTP Domain Name and Password

SW1 – VTP Server Configuration

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1 (config) # **vtp domain ZOOM**
Changing VTP domain name from null to ZOOM
SW1 (config) # **vtp password CCNA**
Setting device VLAN database password to CCNA
SW1 (config) # **^Z**
SW1 #

SW2 – VTP Client Configuration

SW2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW2 (config) # **vtp domain ZOOM**
Changing VTP domain name from null to ZOOM
SW2 (config) # **vtp password CCNA**
Setting device VLAN database password to CCNA
SW2 (config) # **vtp mode client**
Setting device to VTP CLIENT mode.
SW2 (config) # **^Z**
SW2 #

SW1 – Verification:

SW1 # **show vtp status**

VTP Version	:	2
Configuration Revision	:	0
Maximum VLANs supported locally	:	64
Number of existing VLANs	:	5
VTP Operating Mode	:	Server
VTP Domain Name	:	ZOOM
VTP Pruning Mode	:	Disabled
VTP V2 Mode	:	Disabled
VTP Traps Generation	:	Disabled
MD5 digest	:	0x4C 0x9A 0xF5 0x6A 0x05 0xBA 0x83 0xE3

Configuration last modified by 192.168.20.50 at 3-1-93 02:26:12
SW1#

SW1 # **show vtp password**
VTP Password: CCNA
SW1#

SW2 – Verification:

```
SW2 # show vtp status
VTP Version                     :    2
Configuration Revision          :    0
Maximum VLANs supported locally :    64
Number of existing VLANs        :    5
VTP Operating Mode              :    Client
VTP Domain Name                 :    ZOOM
VTP Pruning Mode                :    Disabled
VTP V2 Mode                     :    Disabled
VTP Traps Generation            :    Disabled
MD5 digest                      :    0x4C 0x9A 0xF5 0x6A 0x05 0xBA 0x83 0xE3
Configuration last modified by 192.168.20.50 at 3-1-93 02:26:12
Local updater ID is 192.168.20.50 on interface Vl1 (lowest numbered VLAN interface found)
SW1#
```

```
SW2 # show vtp password
VTP Password: CCNA
SW2#
```

Verify the working of VTP

Create VLANs on Server Switch i.e. **SW1** and verify that these VLANs are automatically available on Client Switch i.e. **SW2**.

SW1 – Configuration

```
SW1 # configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SW1 (config) # vlan 10
SW1 (config-vlan) # name SALES
SW1 (config-vlan) #exit
SW1 (config) # vlan 20
SW1 (config-vlan) # name MKTG
SW1 (config-vlan) #exit
SW1 (config) #
```

SW1 – Verification:

SW1 # **show vlan brief**

```
VLAN Name              Status    Ports
---- ------------------------------- --------- -------------------------------
1    default           active    Fa0/3, Fa0/4, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13,
                                 Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21,
                                 Fa0/22, Fa0/23, Fa0/24
10   SALES             active
20   MKTG              active
1002 fddi-default      act/unsup
1003 trcrf-default     act/unsup
1004 fddinet-default   act/unsup
1005 trbrf-default     act/unsup
SW1 #
```

SW2 – Verification:

SW2 # **show vlan brief**

```
VLAN Name              Status    Ports
---- ------------------------------- --------- -------------------------------
1    default           active    Fa0/3, Fa0/4, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12, Fa0/13,
                                 Fa0/14, Fa0/15, Fa0/16, Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21,
                                 Fa0/22, Fa0/23, Fa0/24
10   SALES             active
20   MKTG              active
1002 fddi-default      act/unsup
1003 trcrf-default     act/unsup
1004 fddinet-default   act/unsup
1005 trbrf-default     act/unsup
SW2 #
```

Try to create VLANs on Client Switch i.e. SW2

SW2 – Verification:

SW2 (config) # **vlan 100**
VTP VLAN configuration not allowed when device is in CLIENT mode.

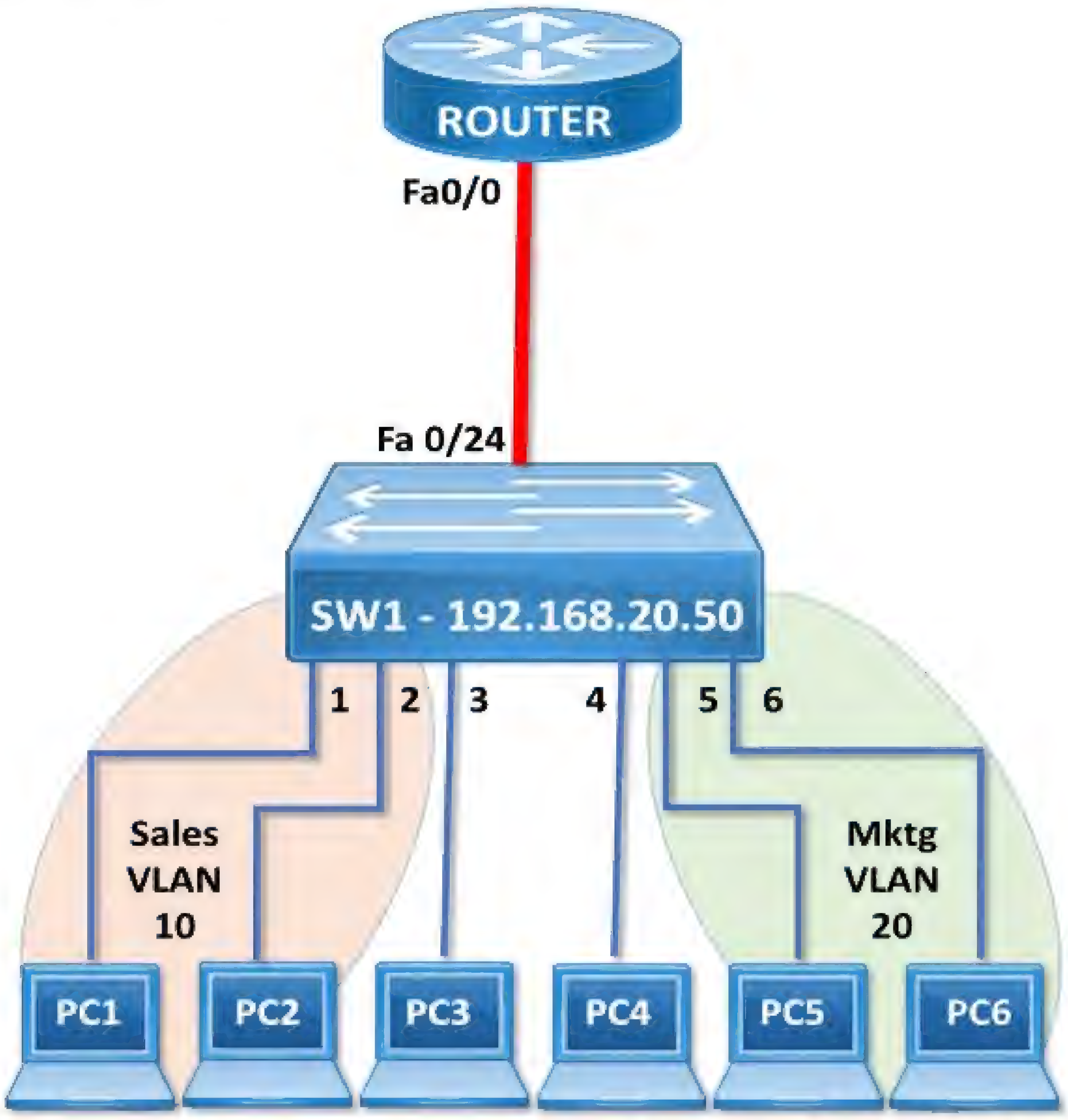
LAB 23: ROUTER ON A STICK (INTER-VLAN ROUTING)

OBJECTIVE:

To configure inter-vlan routing for communication between VLANs, by configuring sub interfaces on a router.

TOPOLOGY:

Setup connectivity for the lab as below :



Computer	Vlan No.	IP Address / Mask	Computer	Vlan No.	IP Address / Mask
PC1	10	192.168.110.1/24	PC5	20	192.168.120.1/24
PC2	10	192.168.110.2/24	PC6	20	192.168.120.2./24

Pre-requisite: VLAN configuration to be done on the switch (LAB – 20)

TASK:

- Verify communication between the computers in Different VLAN
- Configure Sub Interfaces and IP Routing on Router
- Verify communication between the computers in Different VLAN

Verify communication between the computers in Different VLAN

From 192.168.110.1 computer (i.e. PC1)

ping 192.168.110.2

PING 192.168.110.2 (192.168.110.2) 56(84) bytes of data.
64 bytes from 192.168.110.2: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.110.2: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.110.2: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.110.2: icmp_seq=4 ttl=64 time=24.0 ms

ping 192.168.120.2

PING 192.168.120.2 (192.168.120.2) 56(84) bytes of data.
From 192.168.120.2 icmp_seq=1 Destination Host Unreachable
From 192.168.120.2 icmp_seq=2 Destination Host Unreachable
From 192.168.120.2 icmp_seq=3 Destination Host Unreachable
From 192.168.120.2 icmp_seq=3 Destination Host Unreachable

From 192.168.120.1 computer (i.e. PC5)

ping 192.168.110.2

PING 192.168.110.2 (192.168.110.2) 56(84) bytes of data.
From 192.168.110.2 icmp_seq=1 Destination Host Unreachable
From 192.168.110.2 icmp_seq=2 Destination Host Unreachable
From 192.168.110.2 icmp_seq=3 Destination Host Unreachable
From 192.168.110.2 icmp_seq=3 Destination Host Unreachable

ping 192.168.120.2

PING 192.168.120.2 (192.168.120.2) 56(84) bytes of data.
64 bytes from 192.168.120.2: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.120.2: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.120.2: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.120.2: icmp_seq=4 ttl=64 time=24.0 ms

Configure Sub Interfaces and IP Routing on Router

ROUTER – Configuration

ROUTER (config) # **interface FastEthernet 0/0**
ROUTER (config-if) # **no shutdown**
ROUTER (config-if) # **exit**
ROUTER (config) # **interface FastEthernet 0/0.1**
ROUTER (config-subif) # **encapsulation dot1q 10**
ROUTER (config-subif) # **ip address 192.168.110.254 255.255.255.0**
ROUTER (config-subif) # **exit**
ROUTER (config) # **interface FastEthernet 0/0.2**
ROUTER (config-subif) # **encapsulation dot1q 20**
ROUTER (config-subif) # **ip address 192.168.120.254 255.255.255.0**
ROUTER (config-subif) # **exit**
ROUTER (config) # **ip routing**
ROUTER (config) #

ROUTER – Verification

ROUTER # **show ip route**

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
    D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
    E1 - OSPF external type 1, E2 - OSPF external type 2
    i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
    ia - IS-IS inter area, * - candidate default, U - per-user static route
    o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
    + - replicated route, % - next hop override

Gateway of last resort is not set

   192.168.110.0/24 is variably subnetted, 2 subnets, 2 masks
C     192.168.110.0/24 is directly connected, FastEthernet0/0.1
L     192.168.110.254/32 is directly connected, GigabitEthernet0/0.1
   192.168.120.0/24 is variably subnetted, 2 subnets, 2 masks
C     192.168.120.0/24 is directly connected, FastEthernet0/0.2
L     192.168.120.254/32 is directly connected, GigabitEthernet0/0.2
Router #
```

Verify communication between the computers in Different VLAN

From 192.168.110.1 computer (i.e. PC1)

ping 192.168.110.2

PING 192.168.110.2 (192.168.110.2) 56(84) bytes of data.
64 bytes from 192.168.110.2: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.110.2: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.110.2: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.110.2: icmp_seq=4 ttl=64 time=24.0 ms

ping 192.168.120.2

PING 192.168.120.2 (192.168.120.2) 56(84) bytes of data.
64 bytes from 192.168.120.2: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.120.2: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.120.2: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.120.2: icmp_seq=4 ttl=63 time=24.0 ms

From 192.168.120.1 computer (i.e. PC5)

ping 192.168.110.2

PING 192.168.110.2 (192.168.110.2) 56(84) bytes of data.
64 bytes from 192.168.110.2: icmp_seq=1 ttl=63 time=24.0 ms
64 bytes from 192.168.110.2: icmp_seq=2 ttl=63 time=24.0 ms
64 bytes from 192.168.110.2: icmp_seq=3 ttl=63 time=24.1 ms
64 bytes from 192.168.110.2: icmp_seq=4 ttl=63 time=24.0 ms

ping 192.168.120.2

PING 192.168.120.2 (192.168.120.2) 56(84) bytes of data.
64 bytes from 192.168.120.2: icmp_seq=1 ttl=64 time=24.0 ms
64 bytes from 192.168.120.2: icmp_seq=2 ttl=64 time=24.0 ms
64 bytes from 192.168.120.2: icmp_seq=3 ttl=64 time=24.1 ms
64 bytes from 192.168.120.2: icmp_seq=4 ttl=64 time=24.0 ms

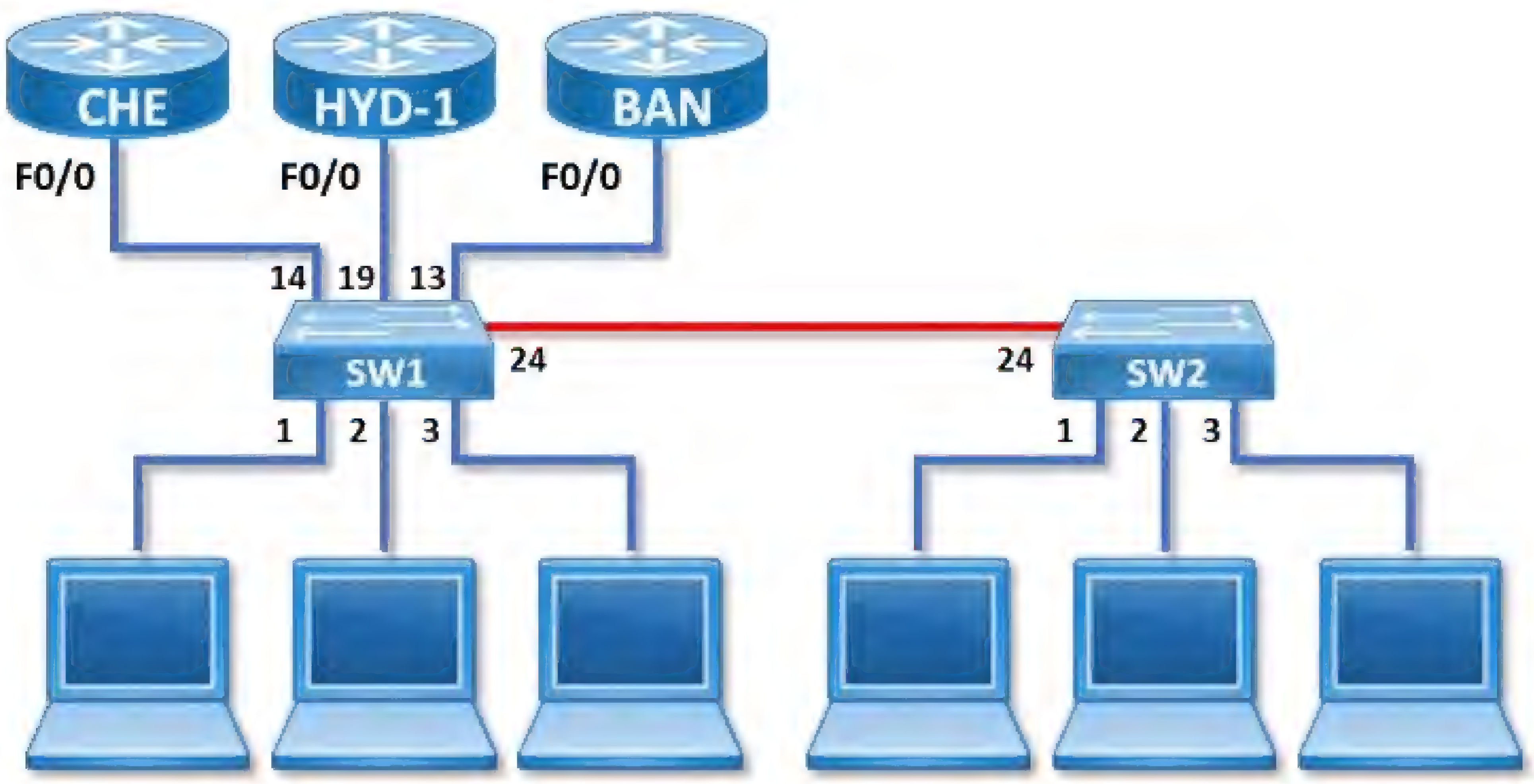
LAB 24: CISCO DISCOVERY PROTOCOL (CDP)

OBJECTIVE:

To enable CDP on routers and switches across the network for layer 2 troubleshooting.

TOPOLOGY:

Setup Switch connectivity for the lab as below:



TASK:

- Enable CDP
- Verify CDP information

Enabling CDP

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1(config)# **cdp run**
SW1 #

Verify CDP information

SW1 – Verification:

SW1 # **show cdp neighbor**
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
SW2	Fas 0/24	127	S I	WS-C2950-2	Fas 0/24
HYD-1	Fas 0/19	145	R S I	Cisco 2821	Gig 0/0
BAN	Fas 0/13	124	R S I	Cisco 2611	Fas 0/0
CHE	Fas 0/14	142	R	2610	Eth 0/0

SW1 #

SW1 # **show cdp neighbor detail**

Device ID: SW2
Entry address(es):
IP address: 192.168.20.51
Platform: cisco WS-C2950-24, Capabilities: Switch IGMP
Interface: FastEthernet0/24, Port ID (outgoing port): FastEthernet0/24
Holdtime : 167 sec

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(13)EA1, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2003 by cisco Systems, Inc.
Compiled Tue 04-Mar-03 02:14 by yenanh

advertisement version: 2
Protocol Hello: OUI=0x00000C, Protocol ID=0x0112; payload len=27,
value=00000000FFFFFFFF010221FF000000000000000D28F06840FF0000
VTP Management Domain: 'zoom'
Duplex: full
Management address(es):

Device ID: HYD-1
Entry address(es):
IP address: 192.168.202.1
Platform: Cisco 2821, Capabilities: Router Switch IGMP
Interface: FastEthernet0/19, Port ID (outgoing port): GigabitEthernet0/0

Holdtime : 126 sec

Version :
Cisco IOS Software, 2800 Software (C2800NM-ADVENTERPRISEK9-M), Version 15.1(3)T2, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2011 by Cisco Systems, Inc.
Compiled Wed 10-Aug-11 05:17 by prod_rel_team

advertisement version: 2
VTP Management Domain: ''
Duplex: full
Management address(es):

Device ID: BAN
Entry address(es):
 IP address: 192.168.203.1
Platform: Cisco 2611XM, Capabilities: Router Switch IGMP
Interface: FastEthernet0/13, Port ID (outgoing port): FastEthernet0/0
Holdtime : 165 sec

Version :
Cisco IOS Software, C2600 Software (C2600-ADVENTERPRISEK9-M), Version 12.4(19), RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Fri 29-Feb-08 19:23 by prod_rel_team

advertisement version: 2
VTP Management Domain: ''
Duplex: full
Management address(es):

Device ID: CHE
Entry address(es):
 IP address: 192.168.201.1
Platform: cisco 2610, Capabilities: Router
Interface: FastEthernet0/14, Port ID (outgoing port): Ethernet0/0
Holdtime : 122 sec

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-IS-M), Version 12.1(4), RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Wed 30-Aug-00 14:11 by cmong

advertisement version: 2
Duplex: half
Management address(es):

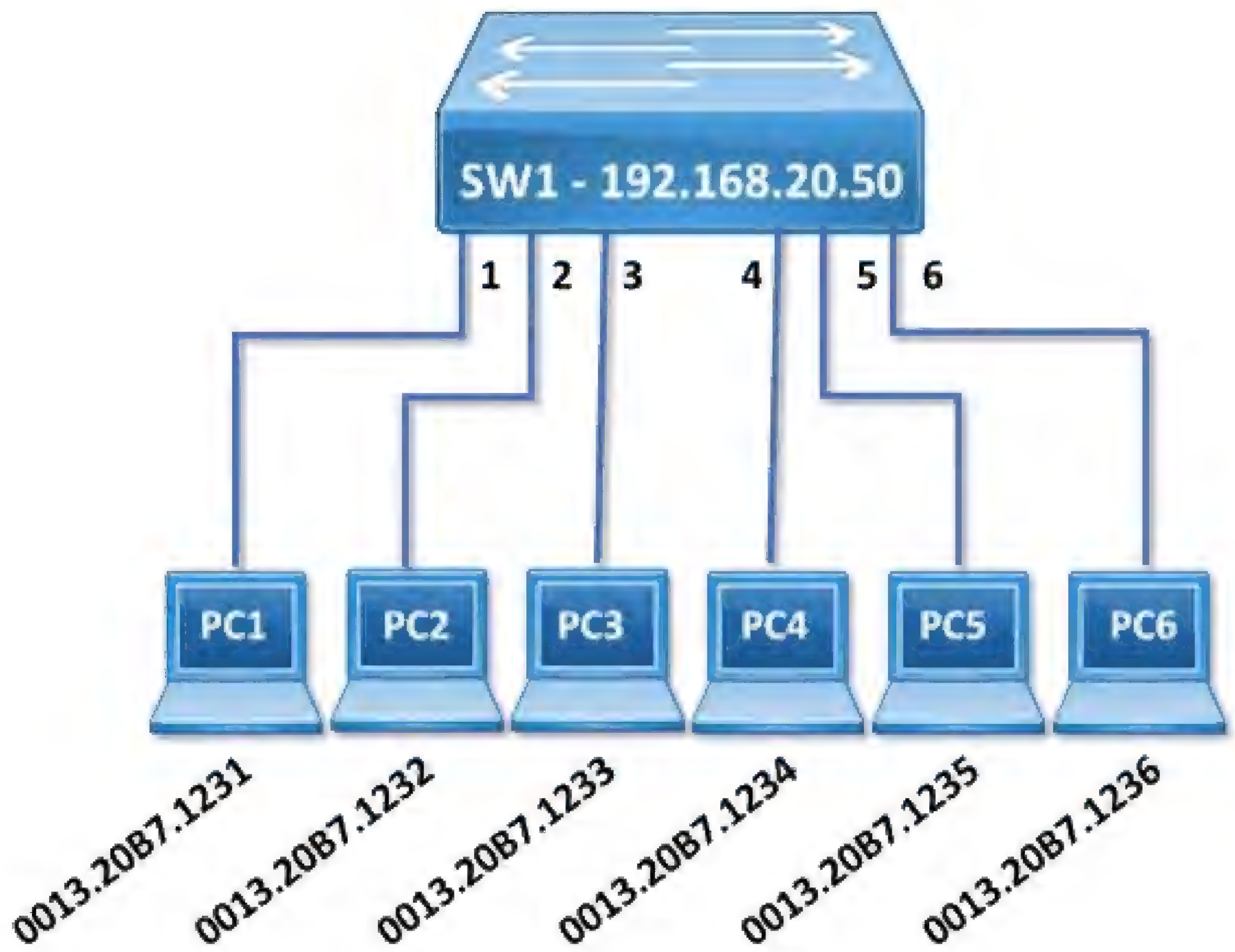
LAB 25: PORT SECURITY

OBJECTIVE:

To implement Port Security on switches across the network.

TOPOLOGY:

Setup Switch connectivity for the lab as below :



TASK:

- Configure Port Security
- Verify Port Security violation
- Configure Port Security Recovery

Configure Port Security

SW1 (config)# **interface fastethernet 0/2**
SW1 (config-if)# **switchport mode access**
SW1 (config-if)# **switchport port-security maximum 1**
SW1 (config-if)# **switchport port-security mac-address 0013.20B7.1232**
SW1 (config-if)# **switchport port-security violation shutdown**
SW1 (config-if)# **switchport port-security**
SW1 (config-if)# **^Z**
SW1 #

Verify Port Security Violation

Connect another computer (with different mac-address) to switch port no. 2 and verify the output.

SW1 – Verification:

SW1 # **show interface status**

```
Port     Name          Status        Vlan    Duplex  Speed Type
Fa0/1                  connected     1       a-full  a-100 10/100BaseTX
Fa0/2                  err-disabled  1       auto    auto 10/100BaseTX
Fa0/3                  connected     1       a-full  a-100 10/100BaseTX
!
<output omitted>
!
Fa0/24                 connected     1       a-full  a-100 10/100BaseTX
SW1#
```

SW1 # **show port-security**

```
Secure Port   MaxSecureAddr   CurrentAddr   SecurityViolation   Security Action
                 (Count)        (Count)          (Count)
---------------------------------------------------------------------------------
Fa0/2              1              1                1                Shutdown
---------------------------------------------------------------------------------
Total Addresses in System (excluding one mac per port)     : 0
Max Addresses limit in System (excluding one mac per port) : 1024
SW1 #
```

Configure Port Security Recovery

```
SW1 # configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SW1 (config)# errdisable recovery cause psecure-violation
SW1 (config)# errdisable recovery interval 30
SW1 (config)# exit


SW1 # show errdisable recovery

ErrDisable Reason        Timer Status
------------------------ --------------
udld                     Disabled
bpduguard                Disabled
security-violatio        Disabled
channel-misconfig        Disabled
vmps                     Disabled
pagp-flap                Disabled
dtp-flap                 Disabled
link-flap                Disabled
psecure-violation        Enabled
gbic-invalid             Disabled
dhcp-rate-limit          Disabled
unicast-flood            Disabled
loopback                 Disabled

Timer interval: 30 seconds

Interfaces that will be enabled at the next timeout:
Interface     Errdisable reason        Time left(sec)
------------- ------------------------ --------------------
 Fa0/2        psecure-violation          15

SW1 #
```

Repeat the above steps by reconfiguring violation command (restrict and protect) and verify the output.

SW1 (config-if)# **switchport port-security violation restrict**

OR

SW1 (config-if)# **switchport port-security violation protect**

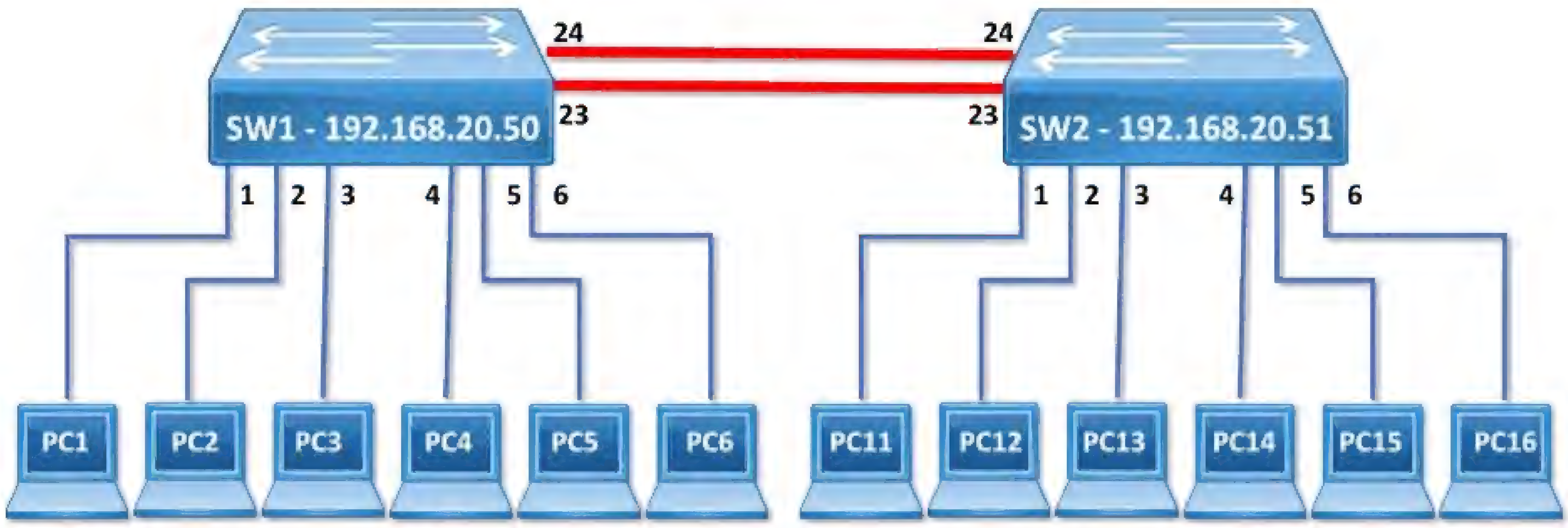
LAB 26: SPANNING TREE PROTOCOL (STP)

OBJECTIVE:

To understand the default behaviour of STP and how a root bridge election takes place.

TOPOLOGY:

Setup Switch connectivity for the lab as below :



TASK:

- Verify STP behaviour
- Change Priority to force a particular switch to become the Root Bridge
- Verify STP

Verify STP default behaviour

SW1 – Verification:

```
SW1 # show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
      Root ID      Priority       32769
                   Address        000c.8577.2040
                   Cost           19
                   Port           23 (FastEthernet0/23)
                   Hello Time     2 sec    Max Age 20 sec        Forward Delay 15 sec

      Bridge ID    Priority       32769  (priority 32768 sys-id-ext 1)
      Address      000d.28f0.6840
      Hello Time   2 sec          Max Age 20 sec        Forward Delay 15 sec
      Aging Time   15

Interface      Role   Sts    Cost    Prio.Nbr    Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7          Desg   FWD    19      128.7       P2p
Fa0/11         Desg   LIS    19      128.11      P2p
Fa0/13         Desg   FWD    19      128.13      P2p
Fa0/19         Desg   FWD    19      128.19      P2p
Fa0/23         Root   FWD    19      128.23      P2p
Fa0/24         Altn   BLK    19      128.24      P2p
SW1 #
```

SW2 – Verification:

```
SW2 # show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
      Root ID      Priority       32769
                   Address        000c.8577.2040
                   This bridge is the root
                   Hello Time     2 sec    Max Age 20 sec        Forward Delay 15 sec

      Bridge ID    Priority       32769  (priority 32768 sys-id-ext 1)
      Address      000c.8577.2040
      Hello Time   2 sec          Max Age 20 sec        Forward Delay 15 sec
      Aging Time   15

Interface      Role   Sts    Cost    Prio.Nbr    Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7          Desg   FWD    19      128.7       P2p
Fa0/13         Desg   FWD    19      128.13      P2p
Fa0/19         Desg   FWD    19      128.19      P2p
Fa0/23         Desg   FWD    19      128.23      P2p
Fa0/24         Desg   FWD    19      128.24      P2p
SW2 #
```

Configuring particular switch to become the Root Bridge

We can configure a switch to become the Root Bridge by giving **root primary** command which sets best bridge priority to become the root bridge. The switch with the lowest priority becomes the Root Bridge with all ports in forwarding state.

SW1 – Configuration

SW1 (config) # **spanning-tree vlan 1 root primary**
SW1 (config) # **end**
SW1 #

SW2 – Configuration

SW2 (config) # **spanning-tree vlan 1 root secondary**
SW2 (config) # **end**
SW2 #

Verify STP

SW1 – Verification:

SW1 # **show spanning-tree**

```
VLAN0001
Spanning tree enabled protocol ieee
    Root ID     Priority        4097
                Address         000d.28f0.6840
                This bridge is the root
                Hello Time      2 sec    Max Age 20 sec        Forward Delay 15 sec

    Bridge ID   Priority        4096  (priority 4096 sys-id-ext 1)
    Address     000d.28f0.6840
    Hello Time  2 sec           Max Age 20 sec        Forward Delay 15 sec
    Aging Time  15

Interface      Role    Sts     Cost    Prio.Nbr    Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7          Desg    FWD     19      128.7       P2p
Fa0/11         Desg    LIS     19      128.11      P2p
Fa0/13         Desg    FWD     19      128.13      P2p
Fa0/19         Desg    FWD     19      128.19      P2p
Fa0/23         Desg    FWD     19      128.23      P2p
Fa0/24         Desg    FWD     19      128.24      P2p
```

SW1 #

SW2 – Verification:

```
SW2 # show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
    Root ID     Priority       4097
                Address        000d.28f0.6840
                Cost           19
                Port           23 (FastEthernet0/23)
                Hello Time     2 sec    Max Age 20 sec         Forward Delay 15 sec


Bridge ID       Priority       28673  (priority 28672 sys-id-ext 1)
    Address     000c.8577.2040
    Hello Time  2 sec          Max Age 20 sec         Forward Delay 15 sec
    Aging Time  15

Interface      Role    Sts    Cost    Prio.Nbr    Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7          Desg    FWD    19      128.7       P2p
Fa0/13         Desg    FWD    19      128.13      P2p
Fa0/19         Desg    FWD    19      128.19      P2p
Fa0/23         Root    FWD    19      128.23      P2p
Fa0/24         Altn    BLK    19      128.24      P2p

SW2 #
```

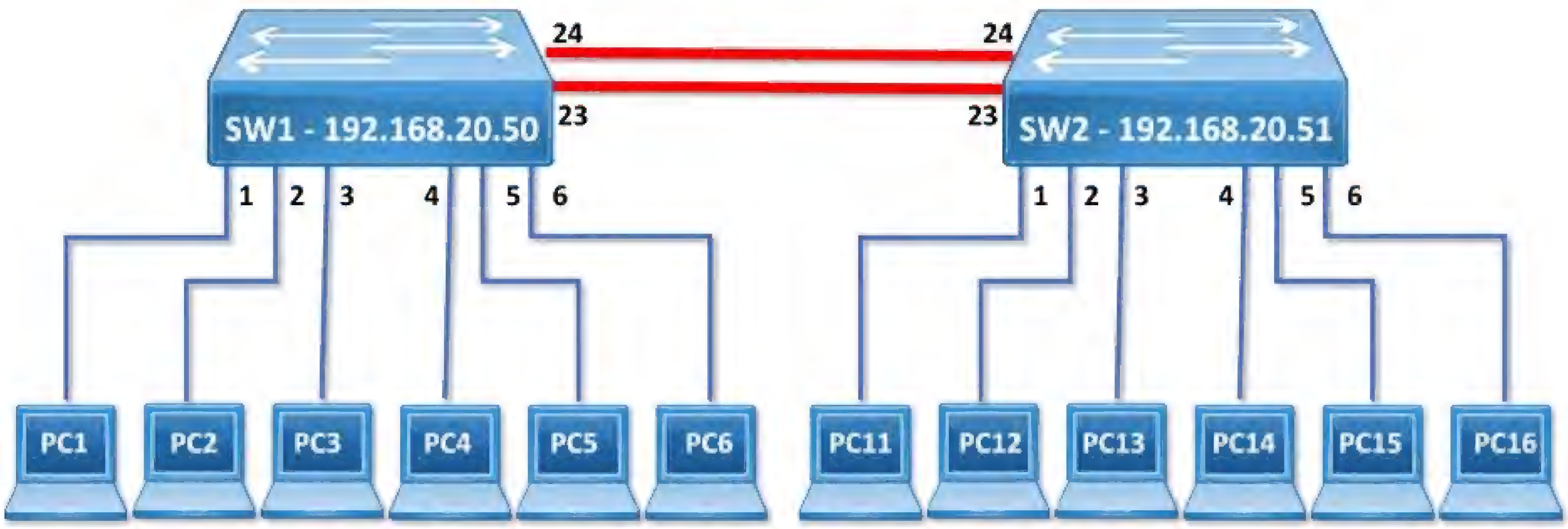
LAB 27 : PORTFAST AND BPDU GUARD

OBJECTIVE:

To understand the states of port in STP and difference after configuring Portfast and BPDU Guard.

TOPOLOGY:

Setup Switch connectivity for the lab as below :



TASK:

- Verify states of port in STP
- Configuring Postfast and BPDU guard for an Interface
- Verify states of port in STP
- Configuring Postfast and BPDU guard for a Switch
- Verify Portfast and BPDU Guard configuration for a switch

Note : PortFast is recommended only for those ports which are directly connected to PCs

Verify Port State in STP after enabling Portfast

SW1 – Configuration

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1 (config) # **interface fastethernet 0/11**
SW1 (config-if) # **shutdown**
SW1 (config-if) # **no shutdown**
SW1 (config-if) # **end**
SW1 #

SW1 – Verification:

Now quickly give **show spanning-tree** mutiple times to view pstates.

SW1 # **show spanning-tree**
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 32769
Address 000c.8577.2040
Cost 19
Port 23 (FastEthernet0/23)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
Address 000d.28f0.6840
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 15

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/7	Desg	FWD	19	128.7	P2p
Fa0/11	Desg	BLK	19	128.11	P2p
Fa0/13	Desg	FWD	19	128.13	P2p
Fa0/19	Desg	FWD	19	128.19	P2p
Fa0/23	Root	FWD	19	128.23	P2p
Fa0/24	Altn	BLK	19	128.24	P2p

SW1 #

SW1 # **show spanning-tree**
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 32769
Address 000c.8577.2040
Cost 19
Port 23 (FastEthernet0/23)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

```
     Bridge ID   Priority       32769  (priority 32768 sys-id-ext 1)
     Address     000d.28f0.6840
     Hello Time  2 sec          Max Age 20 sec        Forward Delay 15 sec
     Aging Time  15

Interface      Role   Sts     Cost    Prio.Nbr    Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7          Desg   FWD     19      128.7       P2p
Fa0/11         Desg   LIS     19      128.11      P2p
Fa0/13         Desg   FWD     19      128.13      P2p
Fa0/19         Desg   FWD     19      128.19      P2p
Fa0/23         Root   FWD     19      128.23      P2p
Fa0/24         Altn   BLK     19      128.24      P2p
SW1 #
```

SW1 # **show spanning-tree**

```
VLAN0001
Spanning tree enabled protocol ieee
     Root ID     Priority       32769
                 Address        000c.8577.2040
                 Cost           19
                 Port           23 (FastEthernet0/23)
                 Hello Time     2 sec    Max Age 20 sec        Forward Delay 15 sec

     Bridge ID   Priority       32769  (priority 32768 sys-id-ext 1)
     Address     000d.28f0.6840
     Hello Time  2 sec          Max Age 20 sec        Forward Delay 15 sec
     Aging Time  15

Interface      Role   Sts     Cost    Prio.Nbr    Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7          Desg   FWD     19      128.7       P2p
Fa0/11         Desg   LRN     19      128.11      P2p
Fa0/13         Desg   FWD     19      128.13      P2p
Fa0/19         Desg   FWD     19      128.19      P2p
Fa0/23         Root   FWD     19      128.23      P2p
Fa0/24         Altn   BLK     19      128.24      P2p
SW1 #
```

SW1 # **show spanning-tree**

```
VLAN0001
Spanning tree enabled protocol ieee
     Root ID     Priority       32769
                 Address        000c.8577.2040
                 Cost           19
                 Port           23 (FastEthernet0/23)
                 Hello Time     2 sec    Max Age 20 sec        Forward Delay 15 sec
```

```
Bridge ID    Priority     32769  (priority 32768 sys-id-ext 1)
Address      000d.28f0.6840
Hello Time   2 sec        Max Age 20 sec       Forward Delay 15 sec
Aging Time   15

Interface     Role    Sts    Cost    Prio.Nbr    Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7         Desg    FWD    19      128.7       P2p
Fa0/11        Desg    FWD    19      128.11      P2p
Fa0/13        Desg    FWD    19      128.13      P2p
Fa0/19        Desg    FWD    19      128.19      P2p
Fa0/23        Root    FWD    19      128.23      P2p
Fa0/24        Altn    BLK    19      128.24      P2p
SW1 #
```

Configuring Postfast and BPDU guard for an Interface

SW1 – Configuration

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1 (config) # **interface fastethernet 0/11**
SW1 (config-if) # **spanning-tree portfast**
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/1 but will only
have effect when the interface is in a non-trunking mode.

SW1 (config-if) # **spanning-tree bpduguard enable**
SW1 (config-if) # **end**
SW1 #

Verify Port State in STP after enabling Portfast

SW1 – Configuration

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1 (config) # **interface fastethernet 0/11**
SW1 (config-if) # **shutdown**
SW1 (config-if) # **no shutdown**
SW1 (config-if) # **end**
SW1 #

SW1 – Verification:

Now quickly give **show spanning-tree** mutiple times to notice that Fa0/11 is placed into **FWD** state immediately.

```
SW1 # show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
    Root ID     Priority      32769
                Address       000c.8577.2040
                Cost          19
                Port          23 (FastEthernet0/23)
                Hello Time    2 sec    Max Age 20 sec        Forward Delay 15 sec

    Bridge ID   Priority      32769  (priority 32768 sys-id-ext 1)
    Address     000d.28f0.6840
    Hello Time  2 sec         Max Age 20 sec        Forward Delay 15 sec
    Aging Time  15

Interface      Role   Sts    Cost   Prio.Nbr   Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7          Desg   FWD    19     128.7      P2p
Fa0/11         Desg   FWD    19     128.11     P2p
Fa0/13         Desg   FWD    19     128.13     P2p
Fa0/19         Desg   FWD    19     128.19     P2p
Fa0/23         Root   FWD    19     128.23     P2p
Fa0/24         Altn   BLK    19     128.24     P2p
SW1 #
```

Configuring Postfast and BPDU guard for a Switch

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.

SW1 (config) # **spanning-tree portfast default**
%Warning: this command enables portfast by default on all interfaces. You
should now disable portfast explicitly on switched ports leading to hubs,
switches and bridges as they may create temporary bridging loops.

SW1 (config) # **spanning-tree portfast bpduguard default**
SW1 (config) # **end**
SW1 #

Verify Portfast and BPDU Guard configuration for switch

SW1 – Verification:

SW 1 # **show spanning-tree summary**
Switch is in pvst mode
Root bridge for: VLAN0001, VLAN0010, VLAN0020
EtherChannel misconfig guard is enabled

Extended system ID	is enabled
Portfast Default	is enabled
PortFast BPDU Guard Default	is enabled
Portfast BPDU Filter Default	is disabled
Loopguard Default	is disabled
UplinkFast	is disabled
BackboneFast	is disabled
Pathcost method used	is short

Name	Blocking	Listening	Learning	Forwarding	STP Active
----------------------	-------------	------------	------------	-----------------	----------------
VLAN0001	0	0	0	8	8
VLAN0010	0	0	0	3	3
VLAN0020	0	0	0	3	3
----------------------	-------------	------------	------------	-----------------	----------------
3 vlans	0	0	0	14	14

SW1 #

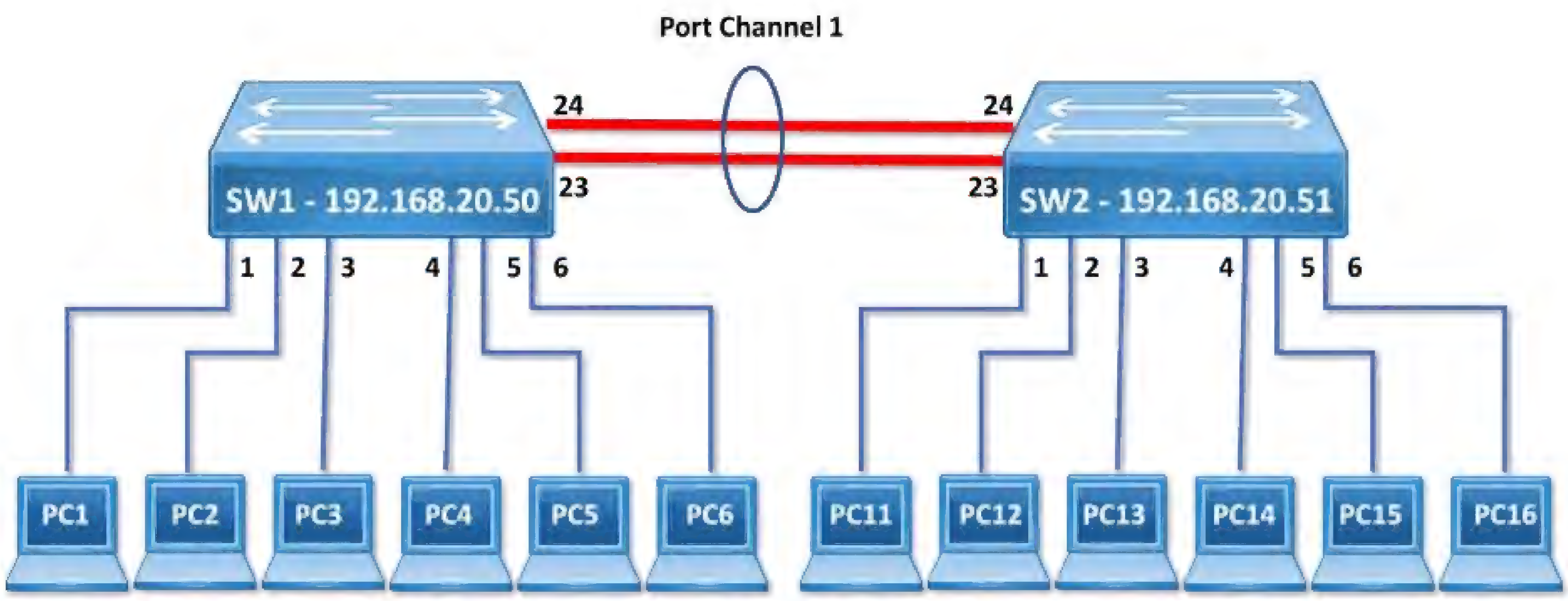
LAB 28: ETHERCHANNEL

OBJECTIVE:

To configure Etherchannel for link aggregation

TOPOLOGY:

Setup Switch connectivity for the lab as below :



TASK:

- Configure Etherchannel
- Verify Etherchannel

Configure Etherchannel

SW1 – Etherchannel Configuration

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1 (config) # **interface range fa 0/23 -24**
SW1 (config-if-range) # **channel-group 1 mode on**
Creating a port-channel interface Port-channel 1
SW1 (config-if-range) # **end**
SW1 #

SW2 – Etherchannel Configuration

SW2 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW2 (config) # **interface range fa 0/23 -24**
SW2 (config-if-range) # **channel-group 1 mode on**
Creating a port-channel interface Port-channel 1
SW2 (config-if-range) # **end**
SW2 #

Verify Etherchannel

SW1 – Verification:

SW1 # **show etherchannel 1 summary**

```
Flags:  D - down        P - bundled in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - LayeBAN     S - LayeHYD-1
        U - in use      f - failed to allocate aggregator

        M - not in use, minimum links not met
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port

Number of channel-groups in use: 1
Number of aggregators: 1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------
  1      Po1(SU)        -        Fa0/23(P) Fa0/24(P)

SW1 #
```

SW1 # **show interface port-channel 1**

```
Port-channel1 is up, line protocol is up (connected)
  Hardware is EtherChannel, address is 000f.8f16.3c17 (bia 000f.8f16.3c17)
  MTU 1500 bytes, BW 200000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Full-duplex, 100Mb/s, media type is unknown media type
  input flow-control is off, output flow-control is off
  Members in this channel: Fa0/23 Fa0/24
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:49, output 00:00:01, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     247 packets input, 18093 bytes, 0 no buffer
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 input packets with dribble condition detected
     222 packets output, 15835 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 PAUSE output
     0 output buffer failures, 0 output buffers swapped out
```

SW1 # **show etherchannel port-channel**

```
                Channel-group listing:
                -----------------------------
Group: 1
----------
                Port-channels in the group:
                ------------------------------------

Port-channel: Po1
------------------------
Age of the Port-channel = 0d:00h:10m:05s
Logical slot/port      = 1/0              Number of ports = 2
GC                     = 0x00000000       HotStandBy port = null
Port state             = Port-channel Ag-Inuse
Protocol               =   -

Ports in the Port-channel:

Index   Load   Port    EC state        No of bits
------+------+------+------------------+-----------
 0      00     Fa0/23  On/FEC            0
 0      00     Fa0/24  On/FEC            0

Time since last port bundled:    0d:00h:20m:05s    Fa0/24
```

SW1 # **show interface status**

```
Port     Name        Status      Vlan     Duplex  Speed Type
Fa0/1                notconnect  1        auto    auto 10/100BaseTX
Fa0/2                notconnect  1        auto    auto 10/100BaseTX
!
<output omitted>
!
Fa0/21               notconnect  1        auto    auto 10/100BaseTX
Fa0/22               notconnect  1        auto    auto 10/100BaseTX
Fa0/23               connected   1        a-full  a-100 10/100BaseTX
Fa0/24               connected   1        a-full  a-100 10/100BaseTX
Po1                  connected   1        a-full  a-100
```

SW1 # show spanning-tree

```
VLAN0001
Spanning tree enabled protocol ieee
    Root ID     Priority      32769
                Address       000c.8577.2040
                Cost          19
                Port          23 (FastEthernet0/23)
                Hello Time    2 sec    Max Age 20 sec        Forward Delay 15 sec

    Bridge ID   Priority      32769  (priority 32768 sys-id-ext 1)
    Address     000d.28f0.6840
    Hello Time  2 sec         Max Age 20 sec        Forward Delay 15 sec
    Aging Time  15

Interface      Role    Sts     Cost    Prio.Nbr    Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7          Desg    FWD     19      128.7       P2p
Fa0/11         Desg    FWD     19      128.11      P2p
Fa0/19         Desg    FWD     19      128.13      P2p
Fa0/20         Desg    FWD     19      128.19      P2p
Fa0/21         Root    FWD     19      128.23      P2p
Fa0/22         Altn    BLK     19      128.24      P2p
Po1            Desg    FWD     12      128.65      P2p

SW1 #
```

SW2 – Verification:

```
SW2 # show etherchannel 1 summary
Flags:  D - down          P - bundled in port-channel
        I - stand-alone   s - suspended
        H - Hot-standby (LACP only)
        R - LayeBAN       S - LayeHYD-1
        U - in use        f - failed to allocate aggregator

        M - not in use, minimum links not met
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port

Number of channel-groups in use: 1
Number of aggregators: 1

Group   Port-channel   Protocol        Ports
---------+-----------------------+--------------+----------------------------------------------
  1       Po1(SU)         -          Fa0/23(P) Fa0/24(P)

SW2 #


SW2 # show interface port-channel 1
Port-channel1 is up, line protocol is up (connected)
 Hardware is EtherChannel, address is 000f.8f16.3c17 (bia 000f.8f16.3c17)
 MTU 1500 bytes, BW 200000 Kbit, DLY 1000 usec,
   reliability 255/255, txload 1/255, rxload 1/255
 Encapsulation ARPA, loopback not set
 Full-duplex, 100Mb/s, media type is unknown media type
 input flow-control is off, output flow-control is off
 Members in this channel: Fa0/23 Fa0/24
 ARP type: ARPA, ARP Timeout 04:00:00
 Last input 00:00:49, output 00:00:01, output hang never
 Last clearing of "show interface" counters never
 Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
 Queueing strategy: fifo
 Output queue: 0/40 (size/max)
 5 minute input rate 0 bits/sec, 0 packets/sec
 5 minute output rate 0 bits/sec, 0 packets/sec
   247 packets input, 18093 bytes, 0 no buffer
   0 runts, 0 giants, 0 throttles
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
   0 input packets with dribble condition detected
   222 packets output, 15835 bytes, 0 underruns
   0 output errors, 0 collisions, 1 interface resets
   0 babbles, 0 late collision, 0 deferred
   0 lost carrier, 0 no carrier, 0 PAUSE output
   0 output buffer failures, 0 output buffers swapped out
```

```
SW2 # show etherchannel port-channel
            Channel-group listing:
            -----------------------------
Group: 1
----------
            Port-channels in the group:
            ------------------------------------

Port-channel: Po1
------------------------
Age of the Port-channel = 0d:00h:10m:05s
Logical slot/port     = 1/0                Number of ports = 2
GC                    = 0x00000000         HotStandBy port = null
Port state            = Port-channel Ag-Inuse
Protocol              =   -

Ports in the Port-channel:

Index   Load   Port     EC state        No of bits
------+------+------+------------------+-----------
  0     00    Fa0/23  On/FEC             0
  0     00    Fa0/24  On/FEC             0

Time since last port bundled:    0d:00h:20m:05s    Fa0/24
```

SW2 # **show interface status**

```
Port      Name         Status       Vlan      Duplex  Speed Type
Fa0/1                  notconnect   1         auto    auto 10/100BaseTX
Fa0/2                  notconnect   1         auto    auto 10/100BaseTX
!
<output omitted>
!
Fa0/21                 notconnect   1         auto    auto 10/100BaseTX
Fa0/22                 notconnect   1         auto    auto 10/100BaseTX
Fa0/23                 connected    1         a-full  a-100 10/100BaseTX
Fa0/24                 connected    1         a-full  a-100 10/100BaseTX
Po1                    connected    1         a-full  a-100
```

SW2 # **show spanning-tree**

```
VLAN0001
Spanning tree enabled protocol ieee
    Root ID     Priority     4097
                Address      000d.28f0.6840
                Cost         19
                Port         23 (FastEthernet0/23)
                Hello Time   2 sec    Max Age 20 sec       Forward Delay 15 sec


Bridge ID       Priority     28673  (priority 28672 sys-id-ext 1)
    Address     000c.8577.2040
    Hello Time  2 sec        Max Age 20 sec       Forward Delay 15 sec
    Aging Time  15

Interface      Role   Sts   Cost   Prio.Nbr   Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/7          Desg   FWD   19     128.7      P2p
Fa0/11         Desg   FWD   19     128.11     P2p
Fa0/19         Desg   FWD   19     128.13     P2p
Fa0/20         Desg   FWD   19     128.19     P2p
Fa0/21         Root   FWD   19     128.23     P2p
Fa0/22         Altn   BLK   19     128.24     P2p
Po1            Desg   FWD   12     128.65     P2p

SW2 #
```

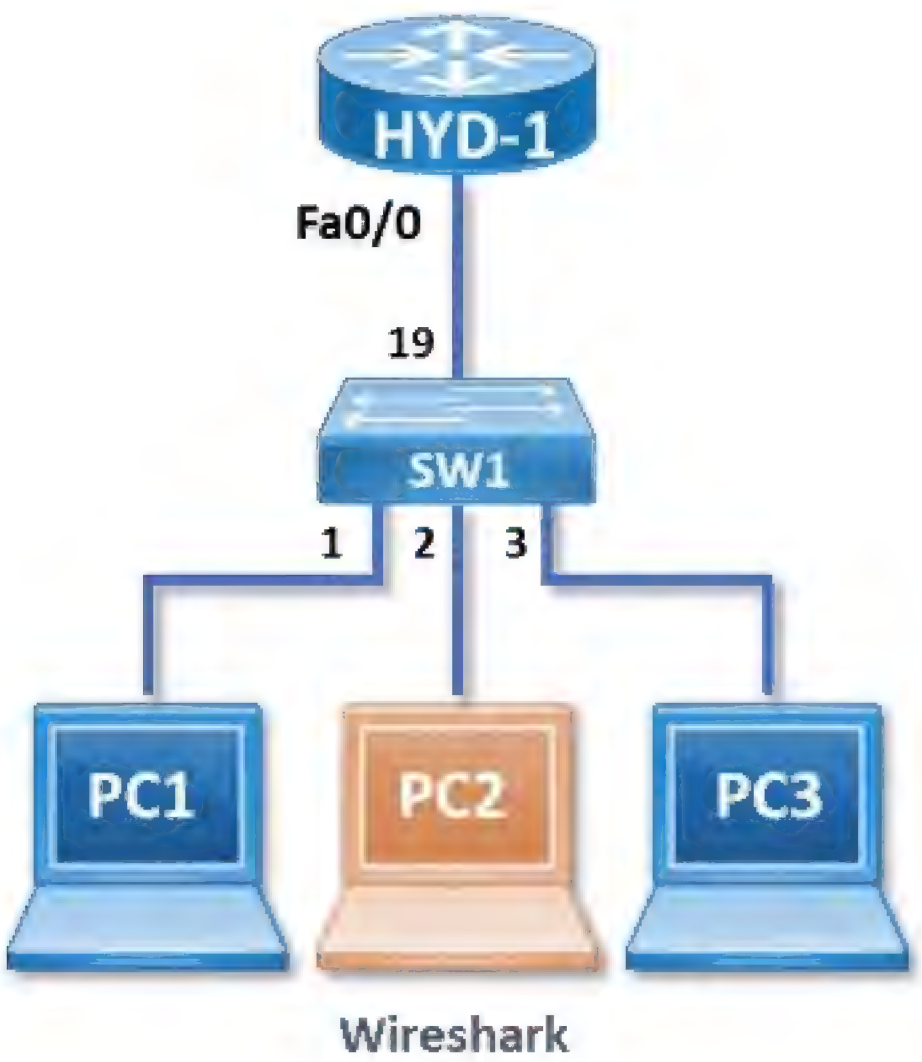
LAB 29: SWITCHED PORT ANALYZER (SPAN)

OBJECTIVE:

To enable SPAN on switch port for capturing data traffic.

TOPOLOGY:

Setup Switch connectivity for the lab as below:



Pre-requisite: Computer should have Wireshark software installed and running.

TASK:

- Enable SPAN
- Verify SPAN

Enabling SPAN

SW1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
SW1(config)# **monitor session 1 source interface fastEthernet 0/11**
SW1(config)# **monitor session 1 destination interface fastEthernet 0/2**

SW1 #

Verify SPAN

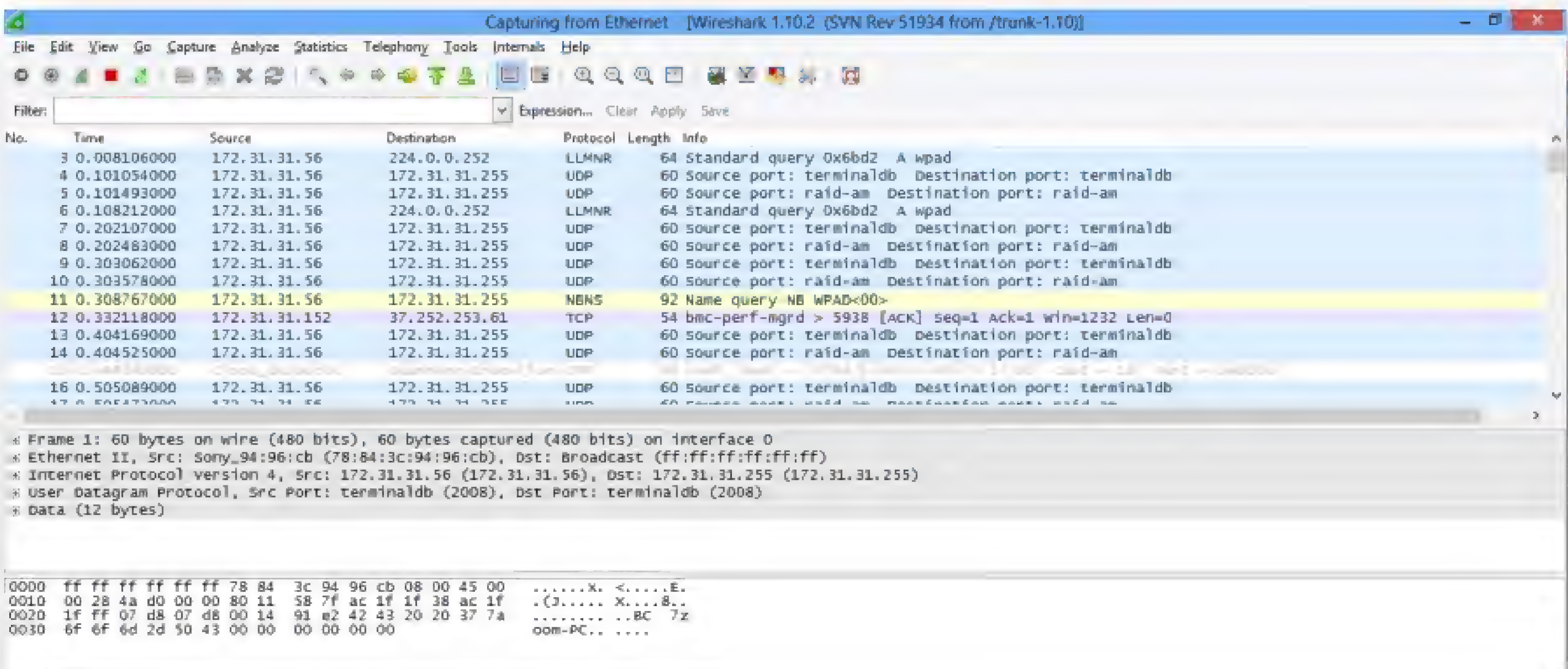
SW1 – Verification:

SW1 # **show monitor**

```
Session 1
-------------
Type              :  Local Session
Source Ports      :
   Both           :  Fa0/9
Destination Ports :  Fa0/8
   Encapsulation  :  Native
         Ingress  :  Disabled
```

Verification on Computer with Wireshark (PC2) :

- Start **Wireshark** Application on PC2 and click **START** button for capturing packets.
- Now Telnet the Router from PC1.
- Verify the packet capturing activity on Wireshark



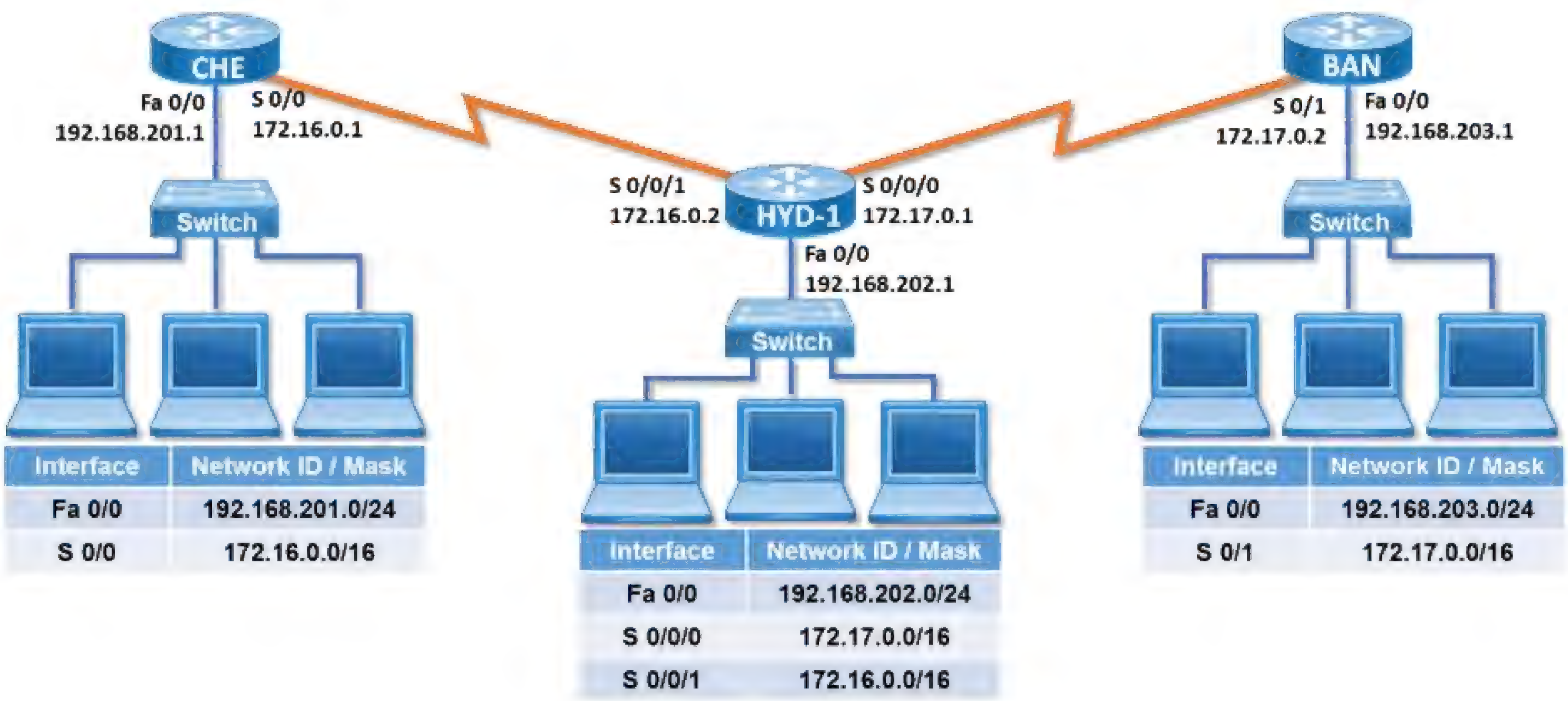
LAB 30: STANDARD ACCESS CONTROL LIST ON IPv4 NETWORK (NUMBERED)

OBJECTIVE:

To configure and implement access-list on HYD-1 such that 192.168.201.10 should not communicate with 192.168.202.0 network

TOPOLOGY:

Configure Ethernet and Serial IP addresses for the lab as below :



Pre-requisite: WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

TASK:

- Verify communication between computers / networks before configuring the access list
- Configure and implement Standard ACL - Numbered
- Verify blocked communication between computers / networks specified in ACL

Verify communication between computers / networks before configuring the access list

From 192.168.201.10 Computer in CHE Network

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

From 192.168.202.20 computer in CHE Network

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

Configure and Implement Standard ACL - Numbered

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **access-list 10 deny 192.168.201.10 0.0.0.0**
HYD-1 (config) # **access-list 10 permit any**
HYD-1 (config) #

HYD-1 (config) # **interface FastEthernet 0/0**
HYD-1 (config-if) # **ip access-group 1 out**
HYD-1 (config-if) # **end**
HYD-1 #

HYD-1 – Verification:

HYD-1 # **show ip access-lists**
Standard IP access list 10
  10 deny   192.168.201.10
  20 permit any
HYD-1#

HYD-1 # **show ip interface FastEthernet 0/0**
FastEthernet0/0 is up, line protocol is up
 Internet address is 192.168.202.1/24
 Broadcast address is 255.255.255.255
 Address determined by setup command
 MTU is 1500 bytes
 Helper address is not set
 Directed broadcast forwarding is disabled
Outgoing access list is 10
 Inbound access list is not set
 Proxy ARP is enabled
 Local Proxy ARP is disabled
 Security level is default
 Split horizon is enabled
 !
<output omitted>
 !
 WCCP Redirect outbound is disabled
 WCCP Redirect inbound is disabled
 WCCP Redirect exclude is disabled
HYD-1#

Verify blocked communication between computers / networks specified in ACL

From 192.168.201.10 computer in CHE Network

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
From 192.168.202.1 icmp_seq=1 Packet filtered
From 192.168.202.1 icmp_seq=2 Packet filtered
From 192.168.202.1 icmp_seq=3 Packet filtered
From 192.168.202.1 icmp_seq=4 Packet filtered
From 192.168.202.1 icmp_seq=5 Packet filtered

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

From 192.168.201.20 computer in CHE Network

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

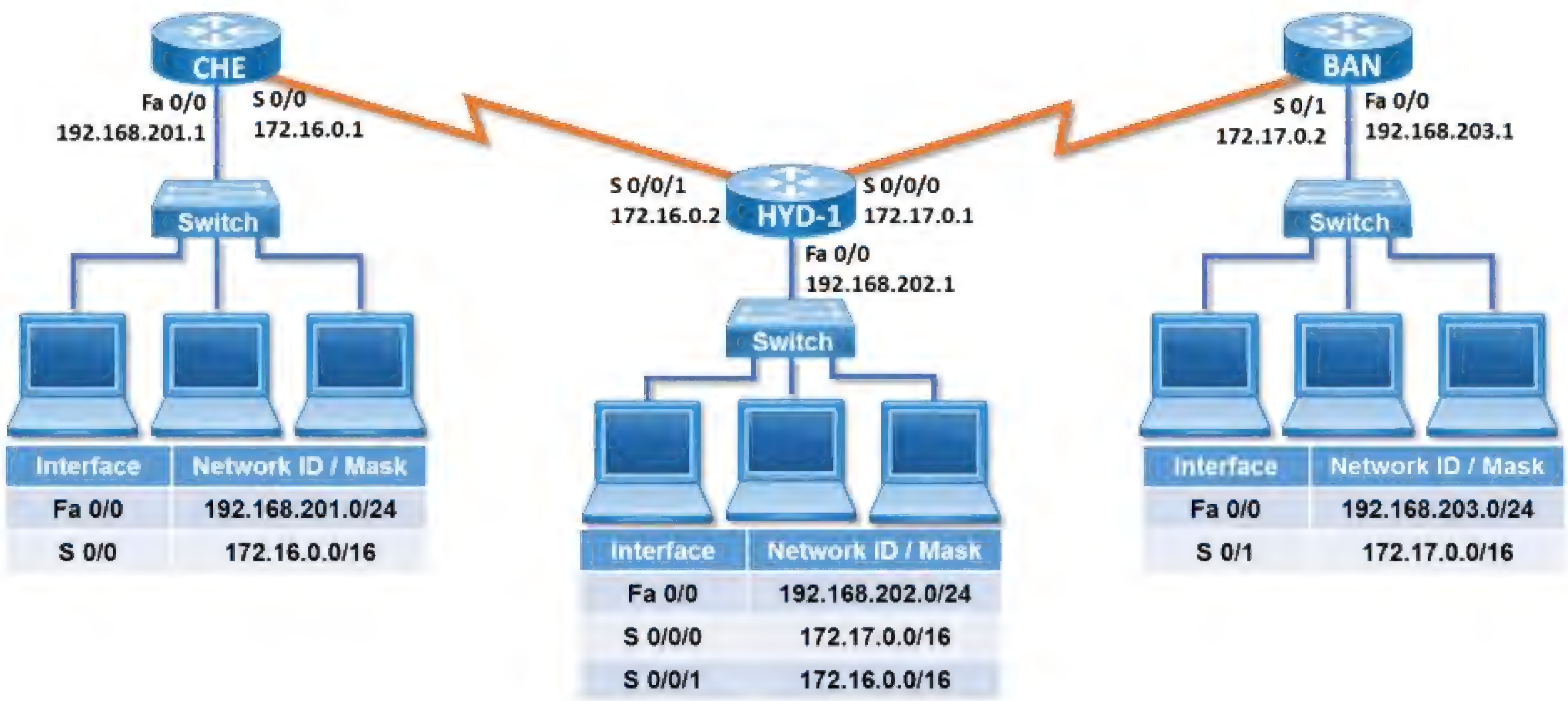
LAB 31: STANDARD ACCESS CONTROL LIST ON IPv4 NETWORK (NAMED)

OBJECTIVE:

To configure and implement access-list on HYD-1 such that 192.168.203.10 should only communicate with 192.168.202.0 network. (Configure ACL with minimum statements)

TOPOLOGY:

Configure Ethernet and Serial IP addresses for the lab as below :



Pre-requisite: WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

TASK:

- Verify communication between computers / networks before configuring the access list
- Configure and implement Standard ACL - Named
- Verify blocked communication between computers / networks specified in ACL

Verify communication between computers / networks before configuring the access list

From 192.168.201.10 Computer in CHE Network

ping 192.168.202.10

```
PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=62 time=24.0 ms
```

ping 192.168.203.10

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

From 192.168.202.20 computer in CHE Network

ping 192.168.202.10

```
PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=62 time=24.0 ms
```

ping 192.168.203.10

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

<u>From 192.168.203.10 Computer in BAN Network</u>

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.201.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.201.10: icmp_seq=29 ttl=62 time=24.2 ms

<u>From 192.168.203.20 computer in BAN Network</u>

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.201.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.201.10: icmp_seq=29 ttl=62 time=24.2 ms

Configure and Implement Standard ACL - Named

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip access-list standard zoom**
HYD-1 (config-std-nacl) # **permit 192.168.203.10 0.0.0.0**
HYD-1 (config-std-nacl) # **exit**
HYD-1 (config) #

HYD-1 (config) # **interface fastethernet 0/0**
HYD-1 (config-if) # **ip access-group zoom out**
HYD-1 (config-if) # **end**
HYD-1 #

HYD-1 – Verification:

HYD-1 # **show ip access-lists**
Standard IP access list zoom
 10 permit 192.168.203.10

HYD-1#

HYD-1 # **show ip interface FastEthernet 0/0**
FastEthernet0/0 is up, line protocol is up
 Internet address is 192.168.202.1/24
 Broadcast address is 255.255.255.255
 Address determined by setup command
 MTU is 1500 bytes
 Helper address is not set
 Directed broadcast forwarding is disabled
Outgoing access list is zoom
 Inbound access list is not set
 Proxy ARP is enabled
 Local Proxy ARP is disabled
 Security level is default
 Split horizon is enabled
 !
<output omitted>
 !
 WCCP Redirect outbound is disabled
 WCCP Redirect inbound is disabled
 WCCP Redirect exclude is disabled
HYD-1#

Verify blocked communication between computers / networks specified in ACL

From 192.168.201.10 Computer in CHE Network

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
From 192.168.202.1 icmp_seq=1 Packet filtered
From 192.168.202.1 icmp_seq=2 Packet filtered
From 192.168.202.1 icmp_seq=3 Packet filtered
From 192.168.202.1 icmp_seq=4 Packet filtered
From 192.168.202.1 icmp_seq=5 Packet filtered

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

From 192.168.202.20 computer in CHE Network

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
From 192.168.202.1 icmp_seq=1 Packet filtered
From 192.168.202.1 icmp_seq=2 Packet filtered
From 192.168.202.1 icmp_seq=3 Packet filtered
From 192.168.202.1 icmp_seq=4 Packet filtered
From 192.168.202.1 icmp_seq=5 Packet filtered

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

<u>From 192.168.203.10 Computer in BAN Network</u>

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
64 bytes from 192.168.202.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.202.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.202.10: icmp_seq=4 ttl=62 time=24.0 ms

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.201.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.201.10: icmp_seq=29 ttl=62 time=24.2 ms

<u>From 192.168.203.20 computer in BAN Network</u>

ping 192.168.202.10

PING 192.168.202.10 (192.168.202.10) 56(84) bytes of data.
From 192.168.202.1 icmp_seq=1 Packet filtered
From 192.168.202.1 icmp_seq=2 Packet filtered
From 192.168.202.1 icmp_seq=3 Packet filtered
From 192.168.202.1 icmp_seq=4 Packet filtered
From 192.168.202.1 icmp_seq=5 Packet filtered

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.201.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.201.10: icmp_seq=29 ttl=62 time=24.2 ms

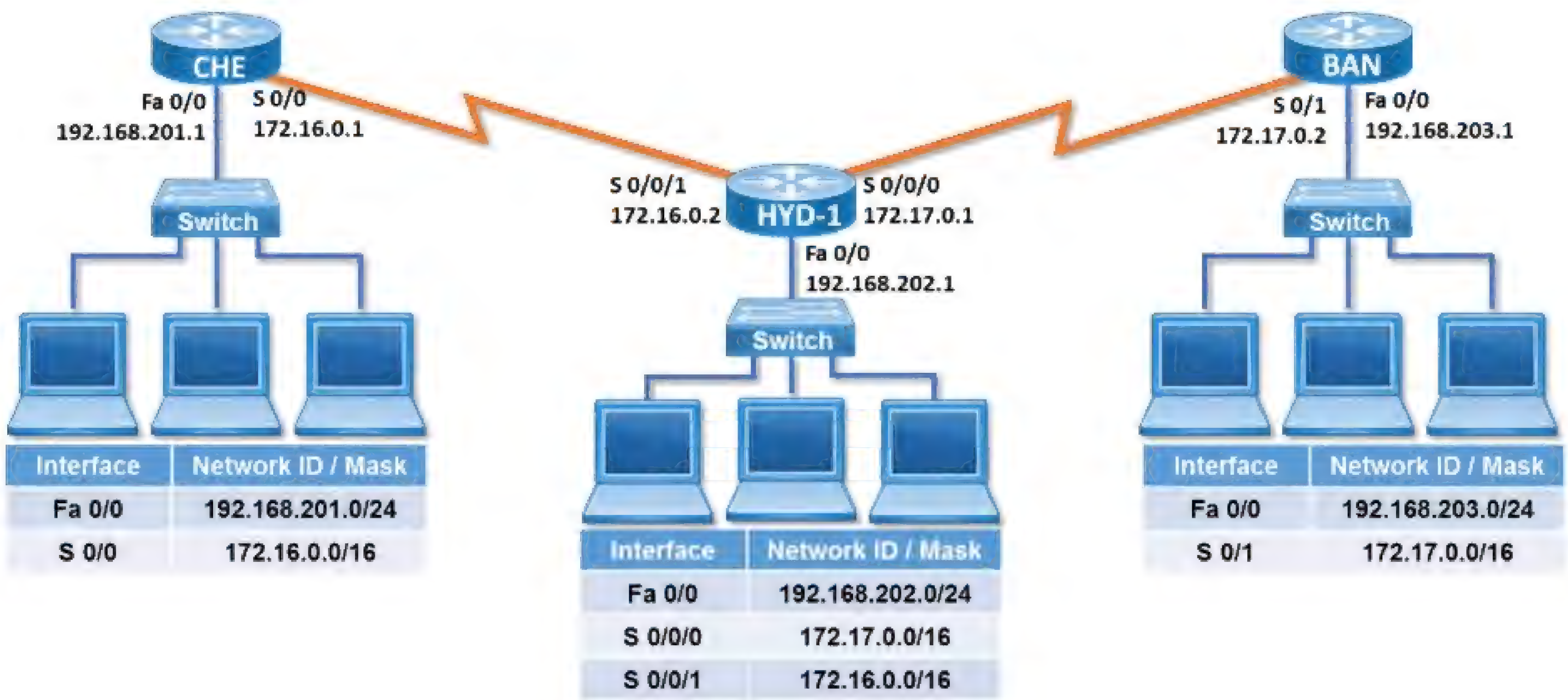
LAB 32: EXTENDED ACCESS CONTROL LIST ON IPv4 NETWORK (NUMBERED)

OBJECTIVE:

Deny HYD-1 Network (i.e. 192.168.202.0/24) from accessing HTTP server (i.e. 192.168.203.10) in BAN Network and also deny ping to CHE Network (i.e. 192.168.201.0/24)

TOPOLOGY:

Configure Ethernet and Serial IP addresses for the lab as below :



Pre-requisite: WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

TASK:

- Verify services and communication between computers / networks before configuring the extended access list.
- Configure and implement Extended ACL - Numbered
- Verify blocked services and communication between computers / networks specified in ACL

Verify services and communication between computers / networks before configuring the Extended Access List

From 192.168.202.10 Computer in HYD-1 Network

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.2 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=5 ttl=62 time=24.1 ms

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

Try to access HTTP Server via browser (i.e. http://192.168.203.10)

You should able to see Test web page, indicates http service is allowed.

Repeat the above verification from 192.168.202.20 Computer in HYD-1 Network and verify the outputs

Configure and Implement Extended ACL - Numbered

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **access-list 101 deny tcp 192.168.202.0 0.255.255.255 192.168.203.10 0.0.0.0 eq www**
HYD-1 (config) # **access-list 101 deny icmp 192.168.202.0 0.255.255.255 192.168.201.0 0.0.0.255 echo**
HYD-1 (config) # **access-list 101 permit ip any any**

HYD-1 (config) # **interface FastEthernet 0/0**
HYD-1 (config-if) # **ip access-group 101 in**
HYD-1 (config-if) # **exit**

HYD-1 – Verification:

HYD-1 # **show ip access-lists**
Extended IP access list 101
  10 deny tcp 192.168.202.0 0.255.255.255 host 192.168.203.10 eq www (5 matches)
  20 deny icmp 192.168.202.0 0.255.255.255 192.168.201.0 0.0.0.255 echo (10 matches)
  30 permit ip any any (87 matches)
HYD-1#

HYD-1 # **show ip interface FastEthernet 0/0**
FastEthernet0/0 is up, line protocol is up
 Internet address is 192.168.202.1/24
 Broadcast address is 255.255.255.255
 Address determined by setup command
 MTU is 1500 bytes
 Helper address is not set
 Directed broadcast forwarding is disabled
 Multicast reserved groups joined: 224.0.0.5 224.0.0.6
 Outgoing access list is not set
Inbound access list is 101
 Proxy ARP is enabled
 Local Proxy ARP is disabled
 Security level is default
 Split horizon is enabled
 !
<output omitted>
 !
 WCCP Redirect outbound is disabled
 WCCP Redirect inbound is disabled
 WCCP Redirect exclude is disabled
HYD-1#

Verify blocked services and communication between computers / networks specified in ACL

From 192.168.202.10 Computer in HYD-1 Network

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
From 192.168.202.1 icmp_seq=1 Packet filtered
From 192.168.202.1 icmp_seq=2 Packet filtered
From 192.168.202.1 icmp_seq=3 Packet filtered
From 192.168.202.1 icmp_seq=4 Packet filtered
From 192.168.202.1 icmp_seq=5 Packet filtered

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

Try to access HTTP Server via browser (i.e. http://192.168.203.10)

You should not able to see Test web page, indicates http service is blocked.

Repeat the above verification from 192.168.202.20 Computer in HYD-1 Network and verify the outputs

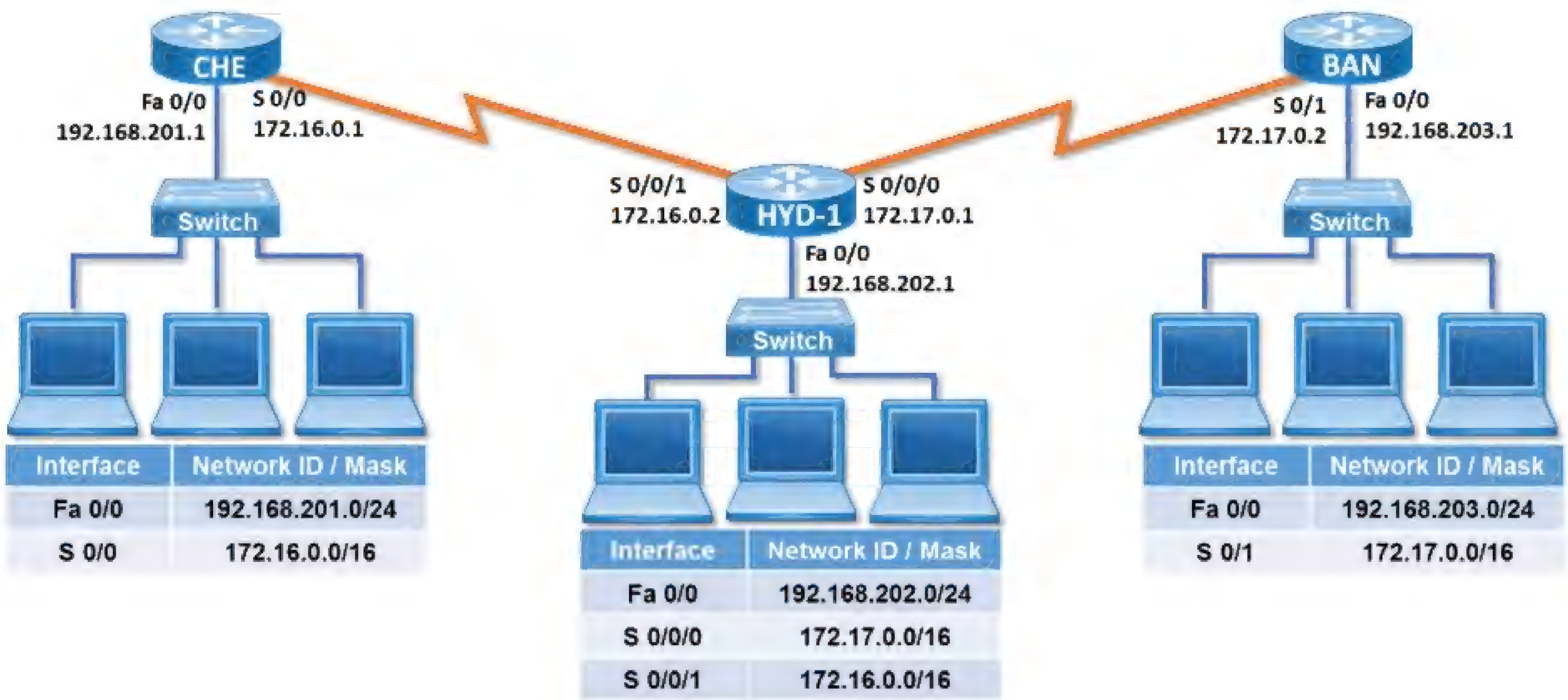
LAB 33: EXTENDED ACCESS CONTROL LIST ON IPv4 NETWORK (NAMED)

OBJECTIVE:

Allow PC from HYD-1 Network (i.e. 192.168.202.10/24) to access FTP server (i.e. 192.168.201.10) in CHE Network. (Configure ACL with minimum statements)

TOPOLOGY:

Configure Ethernet and Serial IP addresses for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	172.16.0.0/16

Interface	Network ID / Mask
Fa 0/0	192.168.202.0/24
S 0/0/0	172.17.0.0/16
S 0/0/1	172.16.0.0/16

Interface	Network ID / Mask
Fa 0/0	192.168.203.0/24
S 0/1	172.17.0.0/16

Pre-requisite: WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

TASK:

- Verify services and communication between computers / networks before configuring the extended access list.
- Configure and implement Extended ACL - Numbered
- Verify blocked services and communication between computers / networks specified in ACL

Verify services and communication between computers / networks before configuring the Extended Access List

From 192.168.202.10 Computer in HYD-1 Network

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.2 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=5 ttl=62 time=24.1 ms

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

Try to access FTP Server via browser (i.e. ftp://192.168.203.10)

You should able to see files on ftp server, indicates ftp service is allowed.

Repeat the above verification from 192.168.202.20 Computer in HYD-1 Network and verify the outputs

Configure and Implement Extended ACL - Numbered

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip access-list extended cisco**
HYD-1(config-ext-nacl) # **permit tcp 192.168.202.10 0.0.0.0 192.168.201.10 0.0.0.0 eq ftp**
HYD-1(config-ext-nacl) # **exit**
HYD-1 (config) #

HYD-1 (config) # **interface FastEthernet 0/0**
HYD-1 (config-if) # **ip access-group cisco in**
HYD-1 (config-if) # **exit**

HYD-1 – Verification:

HYD-1 – Verification:

HYD-1 # **show ip access-lists**
Extended IP access list cisco
  10 deny tcp host 192.168.202.10 0.255.255.255 host 192.168.203.10 eq ftp (2 matches)
HYD-1#

HYD-1 # **show ip interface FastEthernet 0/0**
FastEthernet0/0 is up, line protocol is up
 Internet address is 192.168.202.1/24
 Broadcast address is 255.255.255.255
 Address determined by setup command
 MTU is 1500 bytes
 Helper address is not set
 Directed broadcast forwarding is disabled
 Multicast reserved groups joined: 224.0.0.5 224.0.0.6
 Outgoing access list is not set
Inbound access list is cisco
 Proxy ARP is enabled
 Local Proxy ARP is disabled
 Security level is default
 Split horizon is enabled
 !
<output omitted>
 !
 WCCP Redirect outbound is disabled
 WCCP Redirect inbound is disabled
 WCCP Redirect exclude is disabled
HYD-1#

Verify blocked services and communication between computers / networks specified in ACL

From 192.168.202.10 Computer in HYD-1 Network

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
From 192.168.202.1 icmp_seq=1 Packet filtered
From 192.168.202.1 icmp_seq=2 Packet filtered
From 192.168.202.1 icmp_seq=3 Packet filtered
From 192.168.202.1 icmp_seq=4 Packet filtered
From 192.168.202.1 icmp_seq=5 Packet filtered

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
From 192.168.202.1 icmp_seq=1 Packet filtered
From 192.168.202.1 icmp_seq=2 Packet filtered
From 192.168.202.1 icmp_seq=3 Packet filtered
From 192.168.202.1 icmp_seq=4 Packet filtered
From 192.168.202.1 icmp_seq=5 Packet filtered

Try to access FTP Server via browser (i.e. ftp://192.168.203.10)

You should able to see files on ftp server, indicates ftp service is allowed.

Repeat the above verification from 192.168.202.20 Computer in HYD-1 Network and verify the outputs

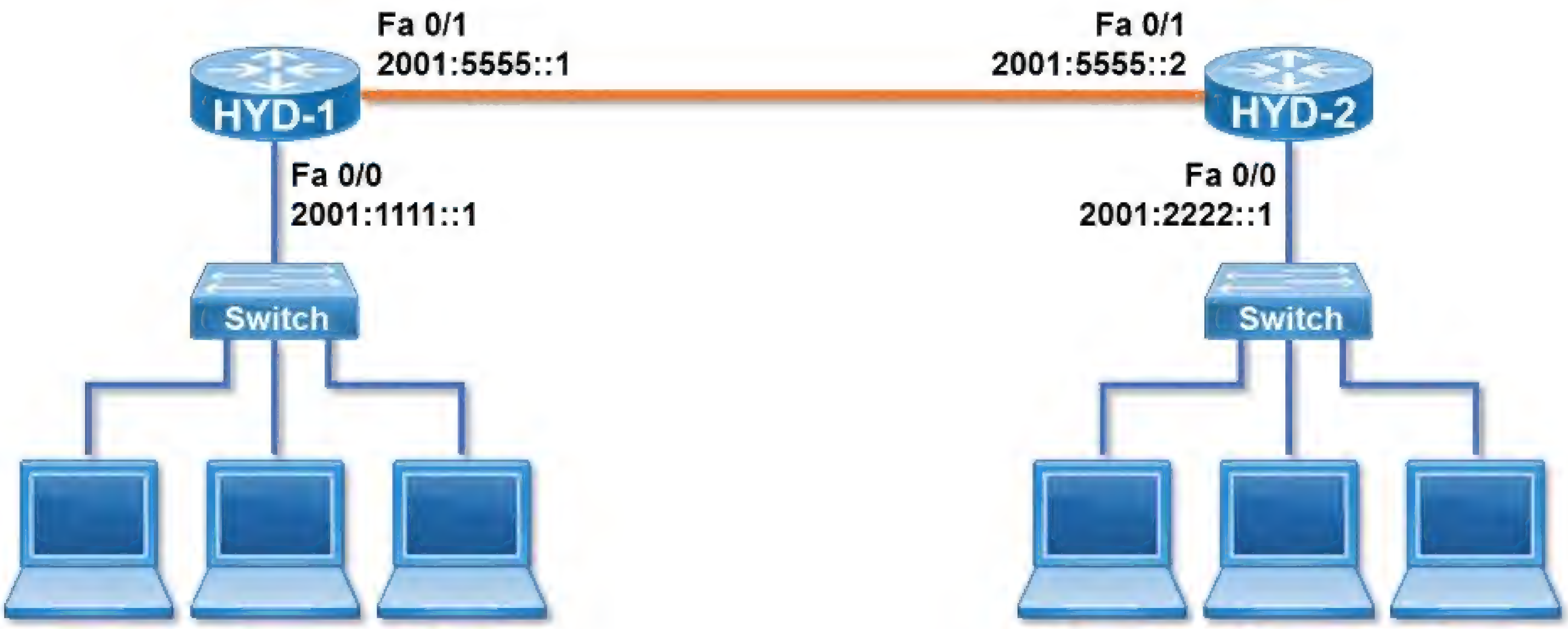
LAB 34: ACCESS CONTROL LIST ON IPv6 NETWORK

OBJECTIVE:

Deny HYD-1 Network - PC (i.e. 2001:1111::10/64) from accessing HTTP server (i.e. 2001:2222::10/64) in HYD-2 Network.

TOPOLOGY:

Configure Ethernet IP addresses for the lab as below :



Interface	Network ID / Mask
Fa 0/0	2001:1111::/64
Fa 0/1	2001:5555::/64

Interface	Network ID / Mask
Fa 0/0	2001:2222::/64
Fa 0/1	2001:5555::/64

Pre-requisite: WAN Interface and Routing configuration to be done on the router (LAB – 3 and 4)

TASK:

- Verify communication between computers / networks before configuring the access list
- Configure and implement IPv6 ACL
- Verify blocked communication between computers / networks specified in ACL

Verify communication between computers / networks before configuring the access list

From 2001:1111::10 Computer in HYD-1 Network

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms

Try to access HTTP Server via browser (i.e. http://2001:2222::10)

You should able to see Test web page, indicates http service is allowed.

From 2001:1111::20 Computer in HYD-1 Network

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms

Try to access HTTP Server via browser (i.e. http://2001:2222::10)

You should able to see Test web page, indicates http service is allowed.

Configure and Implement Extended ACL - Named

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ipv6 access-list cisco**
HYD-1 (config-ipv6-acl) # **deny tcp 2001:1111::10/64 2001:2222::10/64 eq 80**
HYD-1 (config-ipv6-acl) # **permit ipv6 any any**
HYD-1(config-ipv6-acl) # **exit**
HYD-1 (config) #

HYD-1 (config) # **interface FastEthernet 0/0**
HYD-1 (config-if) # **ipv6 traffic-filter cisco in**
HYD-1 (config-if) # **exit**
HYD-1 (config)#

HYD-1 – Verification:

HYD-1 # **show ipv6 access-list**
IPv6 access list cisco
  deny tcp 2001:1111::/64 2001:2222::/64 eq www sequence 10
  permit ipv6 any any (22 matches) sequence 20

HYD-1#

Verify blocked communication between computers / networks specified in ACL

From 2001:1111::10 Computer in HYD-1 Network

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

From 2001:1111::1 icmp_seq=1 Packet filtered
From 2001:1111::1 icmp_seq=2 Packet filtered
From 2001:1111::1 icmp_seq=3 Packet filtered
From 2001:1111::1 icmp_seq=4 Packet filtered
From 2001:1111::1 icmp_seq=5 Packet filtered

Try to access HTTP Server via browser (i.e. http://2001:2222::10)

You should not able to see Test web page, indicates http service is blocked.

From 2001:1111::20 Computer in HYD-1 Network

ping 2001:2222::10 (Windows) or ping6 2001:2222::10 (Linux)

PING 2001:2222::10(2001:2222::10) 56 data bytes
64 bytes from 2001:2222::10: icmp_seq=1 ttl=62 time=0.494 ms
64 bytes from 2001:2222::10: icmp_seq=2 ttl=62 time=0.361 ms
64 bytes from 2001:2222::10: icmp_seq=3 ttl=62 time=0.335 ms
64 bytes from 2001:2222::10: icmp_seq=4 ttl=62 time=0.336 ms

Try to access HTTP Server via browser (i.e. http://2001:2222::10)

You should able to see Test web page, indicates http service is allowed.

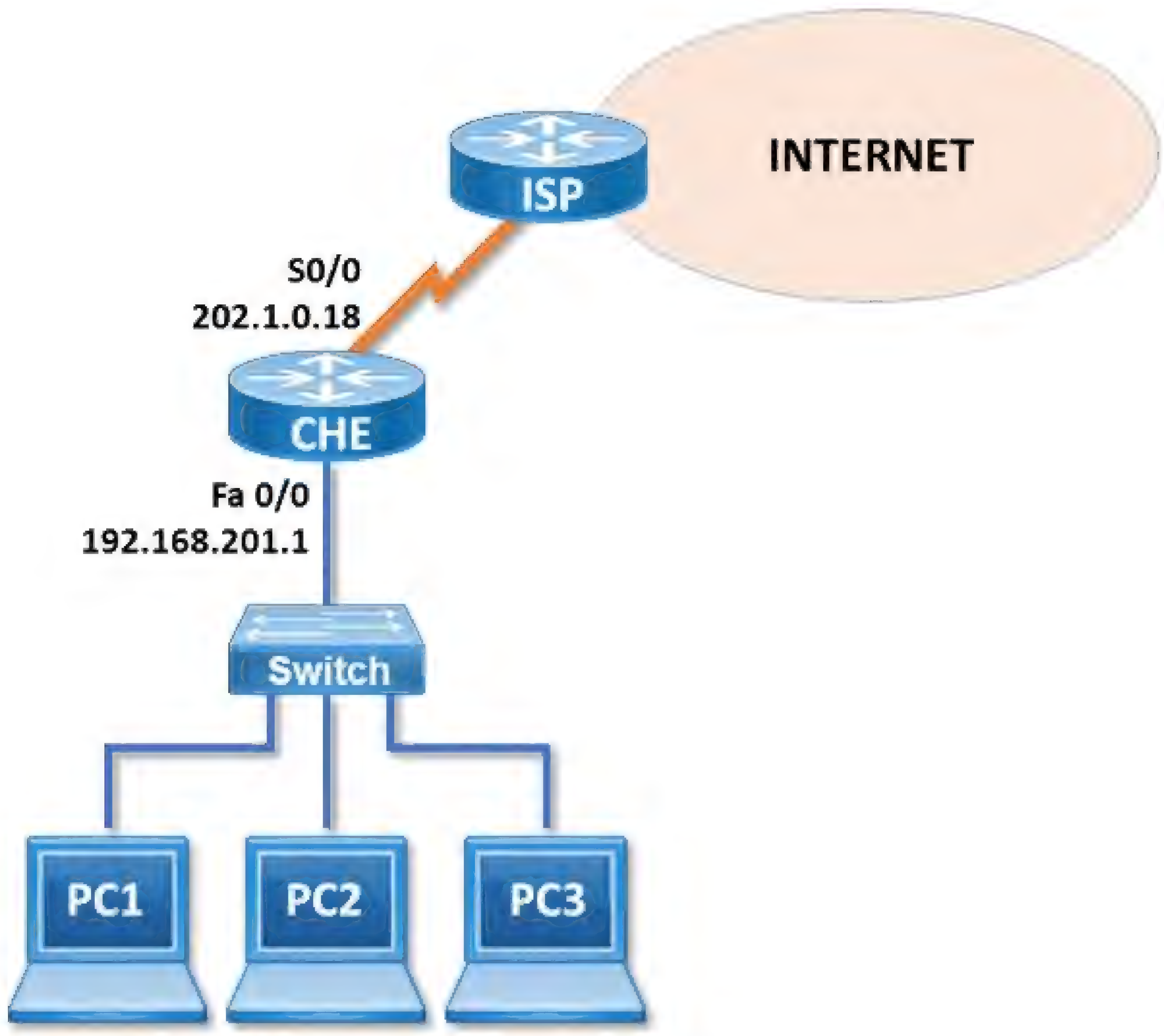
LAB 35: DEFAULT ROUTING

OBJECTIVE:

To configure default routing for accessing Internet.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	202.1.0.16/29

TASK:

- Configure WAN Interface
- Configure Default Routing
- Verify Default Routing
- Verify communication from LAN to the Internet

Configure WAN Interface

Configure WAN Interface IP address according to topology diagram (i.e. IP addresses provided by ISP)

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config)# **interface serial 0/0**
CHE (config-if)# **ip address 202.1.0.18 255.255.255.248**
CHE (config-if)# **no shutdown**
CHE (config-if)# **encapsulation ppp**
CHE (config-if)# **exit**
CHE (config)#

Configure Default Routing

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip route 0.0.0.0 0.0.0.0 Serial0/0**
CHE (config) # **exit**
CHE (config) #

Verify Default Routing

Once Default routing is configured IP Network defined through the **default routing command** is added into the routing information table. **"*"** represents **Default route.**

CHE – Verification:

CHE # **show ip route**

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    202.1.0.16/29 is directly connected, Serial0/0
C    192.168.201.0/24 is directly connected, FastEthernet0/0
S*    0.0.0.0/0 [1/0] via Serial0/0
CHE #
```

Verify communication from LAN to the Internet.

Verification from PC1

ping 8.8.8.8

```
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=62 time=24.0 ms
```

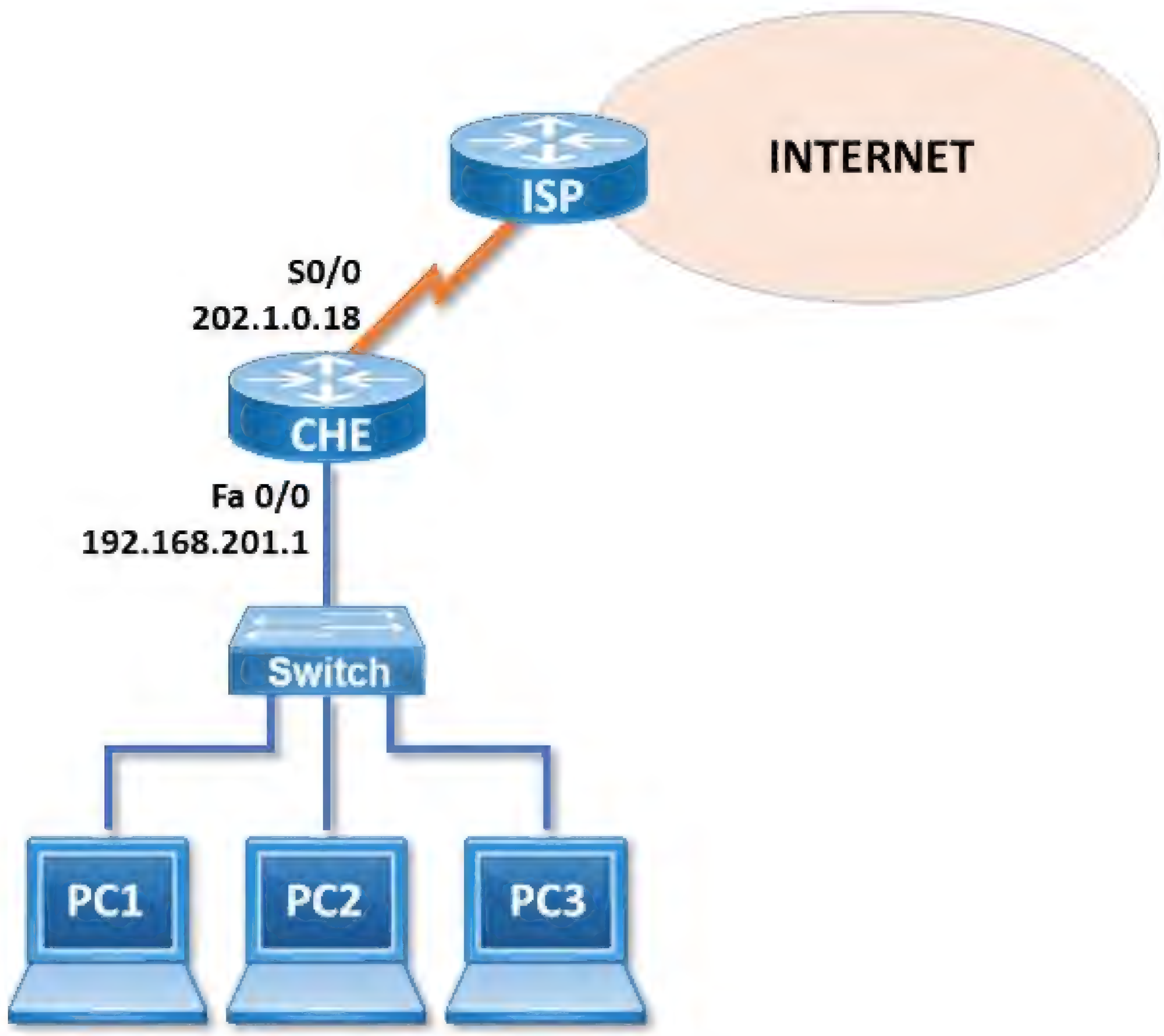
LAB 36: STATIC NAT

OBJECTIVE:

To configure Static NAT for Hosting Pubic Servers on the Internet.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	202.1.0.16/29

Pre-requisite: Default Routing configuration to be done on the router (LAB – 31)

TASK:

- Configure Static NAT
- Verify Static NAT
- Verify Static NAT Packets
- Verify communication from Internet to Server

Configure Static NAT

CHE (config) # **interface serial 0/0**
CHE (config-if) # **ip nat outside**
CHE (config-if) # **exit**
CHE (config) # **interface FastEthernet 0/0**
CHE (config-if) # **ip nat inside**
CHE (config-if) # **exit**
CHE (config)# **ip nat inside source static 192.168.201.10 202.1.0.19**

Verify Static NAT

CHE – Verification

CHE # **show ip nat translation**

Pro	Inside global	Inside local	Outside local	Outside global
---	202.1.0.19	192.168.201.10	---	---

CHE #

CHE # **show ip nat statistics**
Total active translations: 1 (1 static, 0 dynamic; 0 extended)
Outside interfaces:
 Serial0/0
Inside interfaces:
 FastEthernet0/0
Hits: 0 Misses: 0
Expired translations: 0
Dynamic mappings:
CHE#

Verify Static NAT Packets

Verify Static NAT Packets by enabling debug commands

CHE # **debug ip nat**
IP NAT debugging is on
CHE # **terminal monitor**
CHE #
00:16:38: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22575]
00:16:38: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4074]
00:16:39: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22576]
00:16:39: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4075]
00:16:40: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22577]
00:16:40: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4076]
00:16:41: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22578]
00:16:41: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4077]
CHE #

Verification from Outside PC (Internet PC) to LAN (Server)

ping 202.1.0.19

PING 202.1.0.19 (202.1.0.19) 56(84) bytes of data.
64 bytes from 202.1.0.19: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 202.1.0.19: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 202.1.0.19: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 202.1.0.19: icmp_seq=4 ttl=62 time=24.0 ms

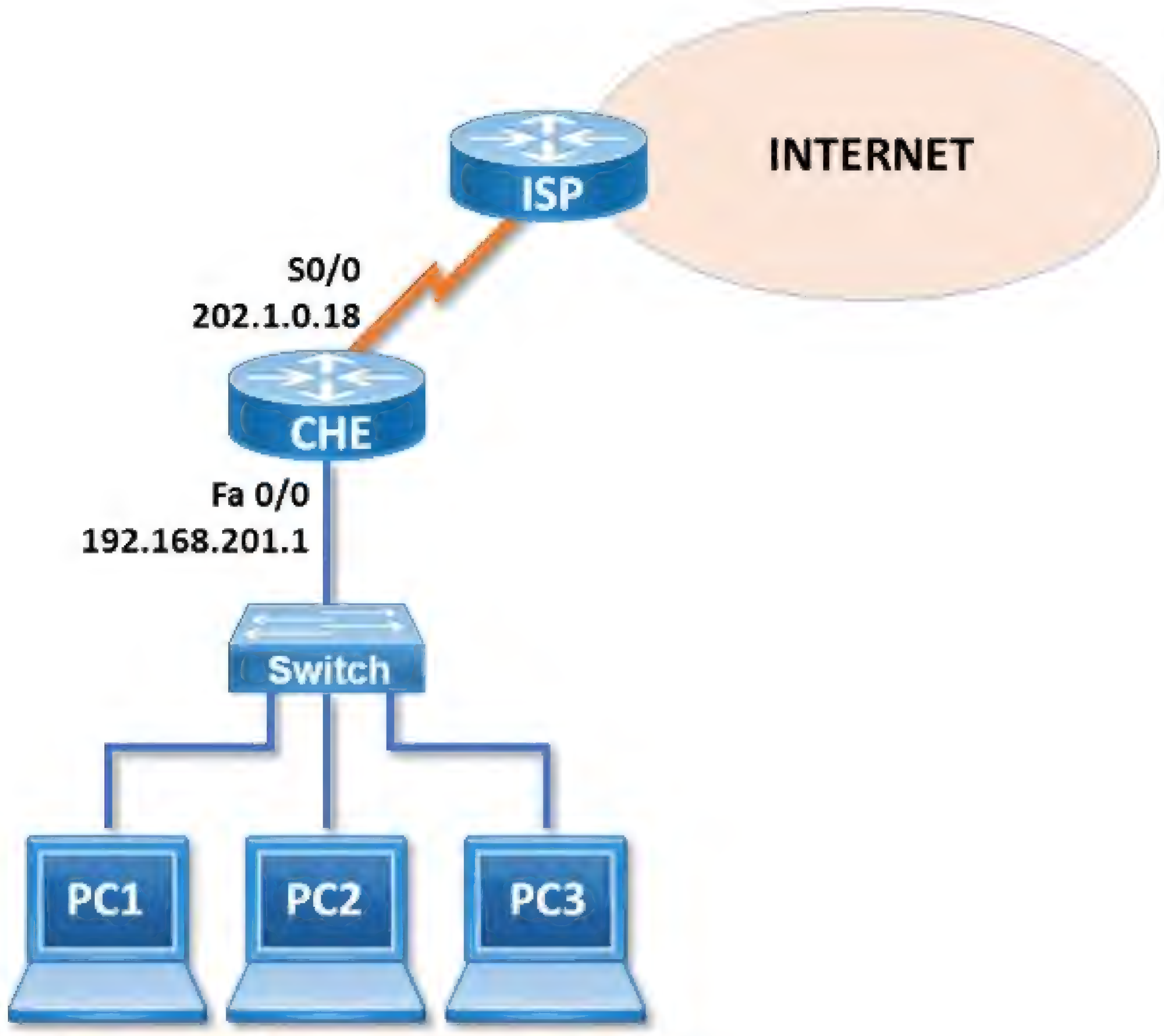
LAB 37: PORT ADDRESS TRANSLATION (PAT)

OBJECTIVE:

To configure PAT for LAN computers to access the Internet using a single Public IP Address.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	202.1.0.16/29

Pre-requisite: Default Routing configuration to be done on the router (LAB – 31)

TASK:

- Configure PAT
- Verify PAT
- Verify PAT Packets
- Verify communication from LAN to the Internet

Configure PAT

CHE (config) # **interface serial 0/0**
CHE (config-if) # **ip nat outside**
CHE (config-if) # **exit**
CHE (config) # **interface FastEthernet 0/0**
CHE (config-if) # **ip nat inside**
CHE (config-if) # **exit**
CHE (config) # **access-list 10 permit 192.168.201.0 0.0.0.255**
CHE (config) # **ip nat inside source list 10 interface serial 0/0 overload**

Verify PAT

CHE – Verification

CHE # **show ip nat translation**

Pro	Inside global	Inside local	Outside local	Outside global
icmp	202.1.0.18:34071	192.168.201.10:34071	202.2.0.17:34071	202.2.0.17:34071
tcp	202.1.0.18:49237	192.168.201.10:49237	202.2.0.17:80	202.2.0.17:80

CHE #

CHE # **show ip nat statistics**
Total active translations: 10 (0 static, 1 dynamic; 0 extended)
Outside interfaces:
 Serial0/0
Inside interfaces:
 FastEthernet0/0
Hits: 20 Misses: 0
Expired translations: 0
Dynamic mappings:
— Inside Source --
[Id: 3] access-list 10 interface Serial0/0

CHE#

Verify PAT Packets

Verify PAT Packets by enabling debug commands

CHE # **debug ip nat**
IP NAT debugging is on
CHE # **terminal monitor**
CHE #
00:16:38: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22575]
00:16:38: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4074]
00:16:39: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22576]
00:16:39: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4075]
00:16:40: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22577]
00:16:40: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4076]
00:16:41: NAT*: s=192.168.201.10->202.1.0.19, d=8.8.8.8 [22578]
00:16:41: NAT*: s=8.8.8.8, d=202.1.0.19->192.168.201.10 [4077]
CHE #

Verify communication from LAN to the Internet.

Verification from PC1

ping 8.8.8.8

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=62 time=24.0 ms

LAB 38: Hot Standby Router Protocol (HSRP)

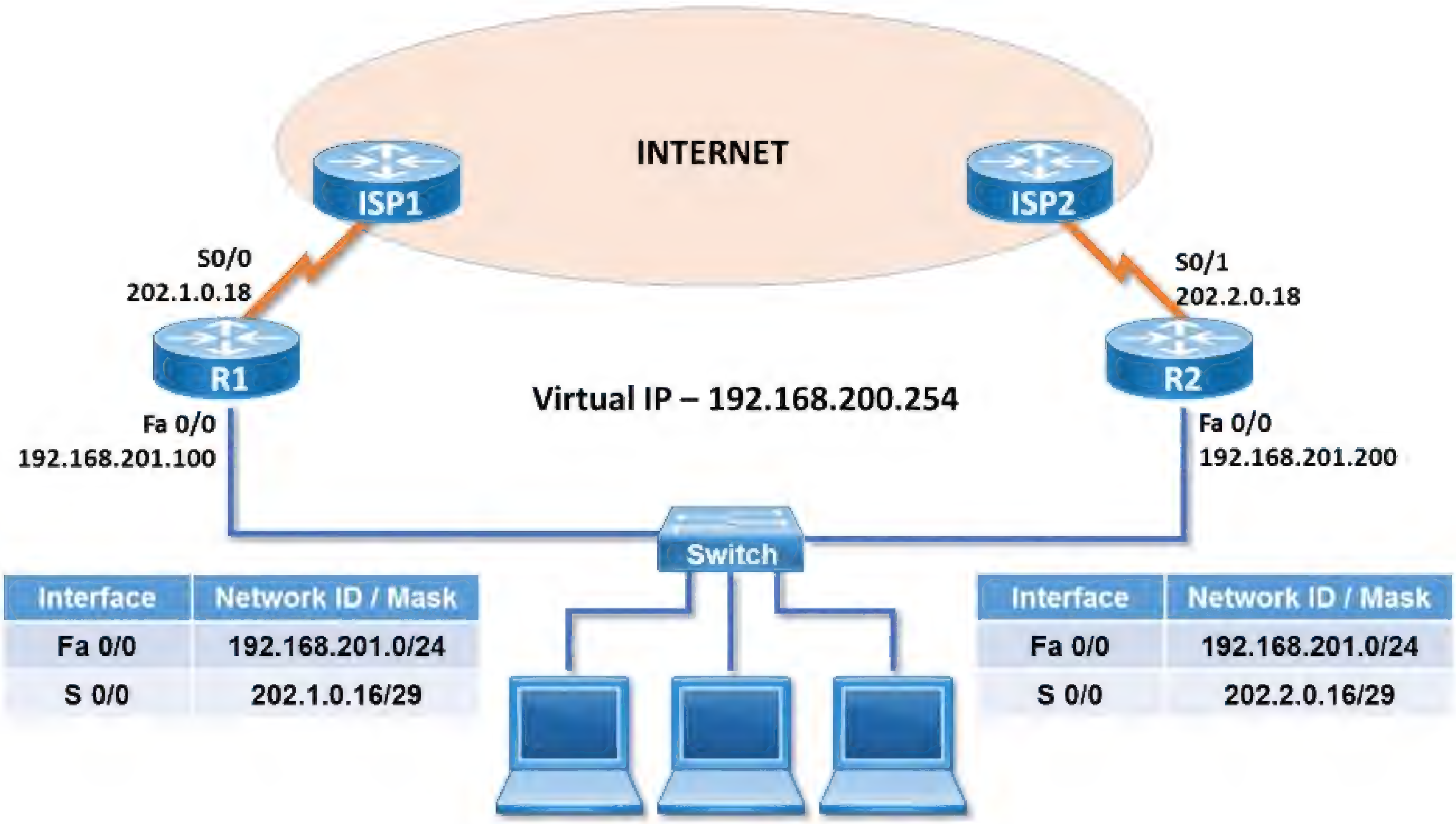
OBJECTIVE:

To set up an always available gateway by configuring HSRP

To set up a virtual default gateway with IP 192.168.201.254 for setting up HSRP

TOPOLOGY:

Setup Serial and Ethernet connectivity for the lab as below:



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	202.1.0.16/29

Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	202.2.0.16/29

- Configure Etherent Interface, Serial Interface and Default Routing
- Configure HSRP
- Verify HSRP
- Verify communication and data path to destination network

Configure Etherent Interface, Serial Interface and Default Routing

R1 – Configuration

R1 (config) # **interface fastethernet 0/0**
R1 (config-if) # **ip address 192.168.201.100 255.255.255.0**
R1 (config-if) # **exit**
R1 (config) # **interface serial 0/0**
R1 (config-if) # **ip address 202.1.0.18 255.255.255.248**
R1 (config-if) # **no shutdown**
R1 (config-if) # **encapsulation ppp**
R1 (config-if) # **exit**
R1 (config) # **ip route 0.0.0.0 0.0.0.0 Serial0/0**
R1 (config) # **exit**

R2 – Configuration

R2 (config) # **interface fastethernet 0/0**
R2 (config-if) # **ip address 192.168.201.100 255.255.255.0**
R2 (config-if) # **exit**
R2 (config) # **interface serial 0/0**
R2 (config-if) # **ip address 202.2.0.18 255.255.255.248**
R2 (config-if) # **no shutdown**
R2 (config-if) # **encapsulation ppp**
R2 (config-if) # **exit**
R2 (config) # **ip route 0.0.0.0 0.0.0.0 Serial0/1**
R2 (config) # **exit**

Configure HSRP

R1 – Configuration

R1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
R1 (config) # **int FastEthernet 0/0**
R1 (config-if) # **standby 10 ip 192.168.201.254**
R1 (config-if) # **standby 10 priority 200**
R1 (config-if) # **end**
R1 #

R2 – Configuration

R1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
R2 (config) # **int FastEthernet 0/0**
R2 (config-if) # **standby 10 ip 192.168.201.254**
R2 (config-if) # **standby 10 priority 150**
R2 (config-if) # **end**
R2 #

Verify HSRP

R1 – Verification

R1 # **show standby**
FastEthernet0/0 - Group 10
 State is Active
  2 state changes, last state change 00:03:21
 Virtual IP address is 192.168.201.254
 Active virtual MAC address is 0000.0c07.ac0a
  Local virtual MAC address is 0000.0c07.ac0a (v1 default)
 Hello time 3 sec, hold time 10 sec
  Next hello sent in 2.792 secs
 Preemption disabled
 Active router is local
 Standby router is 192.168.201.200, priority 150 (expires in 7.848 sec)
 Priority 200 (configured 200)
 IP redundancy name is "hsrp-Fa0/0-10" (default)
R1#

R2 – Verification

R2 # **show standby**
FastEthernet0/0 - Group 10
 State is Standby
  1 state change, last state change 00:01:09
 Virtual IP address is 192.168.201.254
 Active virtual MAC address is 0000.0c07.ac0a
  Local virtual MAC address is 0000.0c07.ac0a (v1 default)
 Hello time 3 sec, hold time 10 sec
  Next hello sent in 2.860 secs
 Preemption disabled
 Active router is 192.168.201.100, priority 200 (expires in 8.802 sec)
 Standby router is local
 Priority 150 (configured 150)
 IP redundancy name is "hsrp-Fa0/0-10" (default)
R2 #

Verify communication and data path to destination network

Verification from a Computer in Network

ping 8.8.8.8

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 8.8.8.8: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 8.8.8.8: icmp_seq=29 ttl=62 time=24.2 ms

From a Computer in Network trace communication path to destination network

```
tracert 8.8.8.8 (Windows) or traceroute 8.8.8.8 (Linux)
traceroute to 8.8.8.8 (192.168.203.10), 30 hops max, 38 byte packets
 1   192.168.201.100 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   8.8.8.8  (8.8.8.8)  2.295 ms  2.156 ms  2.209 ms
```

Understand HSRP behaviour

Currently data is flowing via **R1** router, if **R1** router goes down data will start flowing through **R2** router.

You can verify the behaviour by shutting down **R1** Router Ethernet Interface (LAN Interface) or remove the Ethernet cable from R1 Router and check the behaviour.

Verify HSRP

R1 – Verification

R1 # **show standby**

```
FastEthernet0/0 - Group 10
 State is Standby
  2 state changes, last state change 00:03:21
 Virtual IP address is 192.168.201.250
 Active virtual MAC address is 0000.0c07.ac0a
  Local virtual MAC address is 0000.0c07.ac0a (v1 default)
 Hello time 3 sec, hold time 10 sec
  Next hello sent in 2.792 secs
 Preemption disabled
 Active router is 192.168.201.200, priority 150 (expires in 8.802 sec)
 Standby router is local
 Priority 200 (configured 200)
 IP redundancy name is "hsrp-Fa0/0-10" (default)
R1#
```

R2 – Verification

R2 # **show standby**

```
FastEthernet0/0 - Group 10
 State is Active
  1 state change, last state change 00:01:09
 Virtual IP address is 192.168.201.250
 Active virtual MAC address is 0000.0c07.ac0a
  Local virtual MAC address is 0000.0c07.ac0a (v1 default)
 Hello time 3 sec, hold time 10 sec
  Next hello sent in 2.860 secs
 Preemption disabled
 Active router is local
 Standby router is 192.168.201.100, priority 200 (expires in 7.848 sec)
 Priority 150 (configured 150)
 IP redundancy name is "hsrp-Fa0/0-10" (default)
R2 #
```

Verify communication and data path to destination network

Verification from a Computer in Network

ping 8.8.8.8

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 8.8.8.8: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 8.8.8.8: icmp_seq=29 ttl=62 time=24.2 ms

From a Computer in Network trace communication path to destination network

tracert 8.8.8.8 (Windows) or traceroute 8.8.8.8 (Linux)

```
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets
 1   192.168.201.200 (192.168.201.200)  1.086 ms  1.124 ms  1.144 ms
 2   8.8.8.8  (8.8.8.8)  2.295 ms  2.156 ms  2.209 ms
```

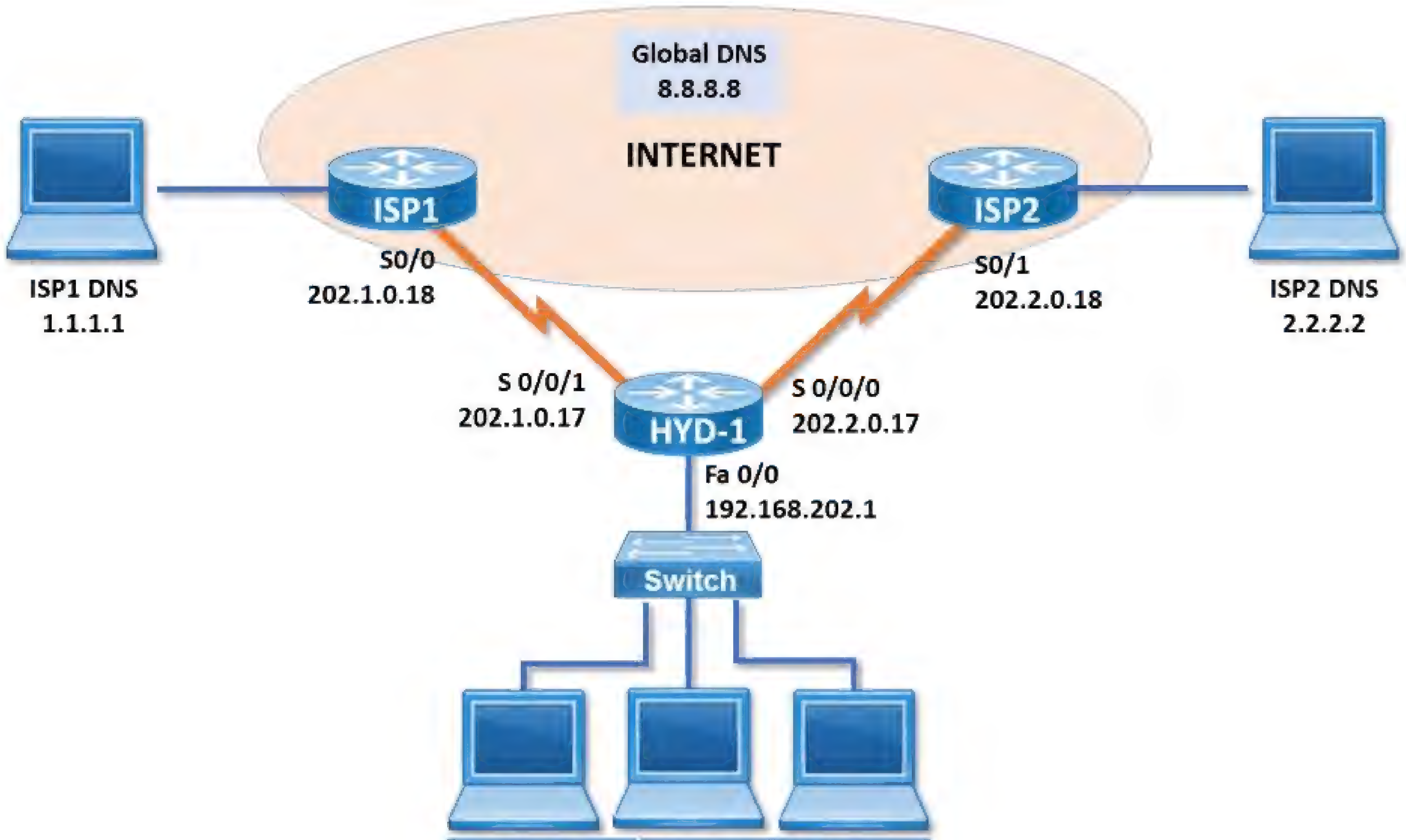
LAB 39: IP SLA

OBJECTIVE:

To configure IP SLA feature to monitor ISP link failure and injecting another default route for backup ISP

TOPOLOGY:

Setup Serial and Ethernet connectivity for the lab as below:



Interface	Network ID / Mask
Fa 0/0	192.168.202.0/24
S 0/0/0	202.1.0.16/29
S 0/0/1	202.2.0.16/29

- Configure Serial Interface and Default Routing
- Configure IP SLA
- Verify IP SLA
- Verify communication and data path to destination network

Configure Serial Interface and Default Routing

HYD-1 – Configuration

HYD-1 (config) # **interface serial 0/0/0**
HYD-1 (config-if) # **ip address 202.2.0.17 255.255.255.248**
HYD-1 (config-if) # **no shutdown**
HYD-1 (config-if) # **encapsulation ppp**
HYD-1 (config-if) # **exit**
HYD-1 (config) # **interface serial 0/0/1**
HYD-1 (config-if) # **ip address 202.1.0.17 255.255.255.248**
HYD-1 (config-if) # **no shutdown**
HYD-1 (config-if) # **encapsulation ppp**
HYD-1 (config-if) # **exit**
HYD-1 (config) # **ip route 0.0.0.0 0.0.0.0 202.1.0.18**
HYD-1 (config) # **ip route 0.0.0.0 0.0.0.0 202.2.0.18 2**
HYD-1 (config) # **exit**
HYD-1 #

Configure IP SLA

HYD-1 – Configuration

R1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip sla 1**
HYD-1 (config-ip-sla) # **icmp-echo 1.1.1.1**
HYD-1 (config-ip-sla-echo) # **frequency 5**
HYD-1 (config-ip-sla-echo) # **exit**

HYD-1 (config) # **ip sla schedule 1 start-time now life forever**
HYD-1 (config) # **track 10 ip sla 1**
HYD-1 (config-track) # **delay down 20 up 10**
HYD-1 (config-track) # **exit**
HYD-1 (config) # **ip route 0.0.0.0 0.0.0.0 202.1.0.18 track 10**
HYD-1 (config) # **end**
HYD-1 #

Verify IP SLA

HYD-1 – Verification

HYD-1 # **sh ip route**
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
+ - replicated route, % - next hop override

Gateway of last resort is 202.1.0.18 to network 0.0.0.0

S* 0.0.0.0/0 [1/0] via 202.1.0.18
192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.202.0/24 is directly connected, FastEthernet0/0
L 192.168.202.1/32 is directly connected, FastEthernet0/0
202.1.0.16/29 is variably subnetted, 2 subnets, 2 masks
C 202.1.0.16/29 is directly connected, Serial0/0/1
L 202.1.0.17/32 is directly connected, Serial0/0/1
202.2.0.16/16 is variably subnetted, 2 subnets, 2 masks
C 202.2.0.0/16 is directly connected, Serial0/0/0
L 202.2.0.17/32 is directly connected, Serial0/0/0
HYD-1 #

Verify communication and data path to destination network

Verification from a Computer in HYD-1 Network

ping 8.8.8.8

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 8.8.8.8: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 8.8.8.8: icmp_seq=29 ttl=62 time=24.2 ms

From a Computer in HYD-1 Network trace communication path to destination network

```
tracert 8.8.8.8 (Windows) or traceroute 8.8.8.8 (Linux)
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   202.1.0.18 (202.1.0.18)  1.086 ms  1.124 ms  1.144 ms
 3   8.8.8.8  (8.8.8.8)  2.295 ms  2.156 ms  2.209 ms
```

Understand IP SLA behaviour

Currently data is flowing via **ISP1**, if **ISP1 DNS Server** goes down or is not reachable data will start flowing through **ISP2**. You can verify the behaviour by shutting dowwn ISP1 DNS Server.

Verify IP SLA

HYD-1 – Verification

```
HYD-1 # sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is 202.2.0.18 to network 0.0.0.0

S*    0.0.0.0/0 [2/0] via 202.2.0.18
192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.202.0/24 is directly connected, FastEthernet0/0
L       192.168.202.1/32 is directly connected, FastEthernet0/0
     202.1.0.16/29 is variably subnetted, 2 subnets, 2 masks
C       202.1.0.16/29 is directly connected, Serial0/0/1
L       202.1.0.17/32 is directly connected, Serial0/0/1
     202.2.0.16/16 is variably subnetted, 2 subnets, 2 masks
C       202.2.0.0/16 is directly connected, Serial0/0/0
L       202.2.0.17/32 is directly connected, Serial0/0/0
HYD-1 #
```

Verify communication and data path to destination network

Verification from a Computer in HYD-1 Network

ping 8.8.8.8

```
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 8.8.8.8: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 8.8.8.8: icmp_seq=29 ttl=62 time=24.2 ms
```

From a Computer in HYD-1 Network trace communication path to destination network

```
tracert 8.8.8.8 (Windows) or traceroute 8.8.8.8 (Linux)
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   202.2.0.18 (202.2.0.18)  1.086 ms  1.124 ms  1.144 ms
 3   8.8.8.8  (8.8.8.8)  2.295 ms  2.156 ms  2.209 ms
```

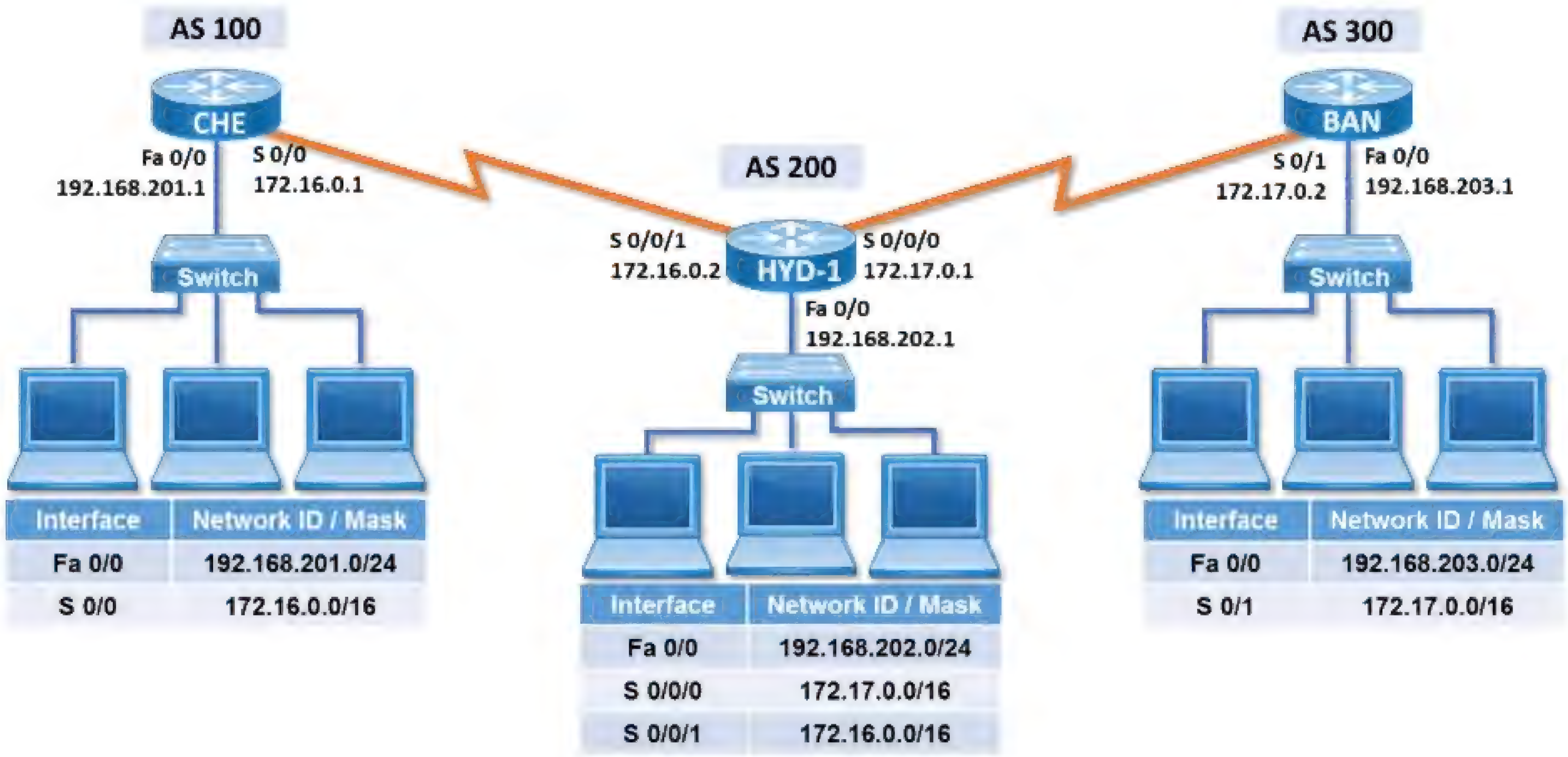
LAB 40: BGP ON IPv4 network

OBJECTIVE:

To configure BGP for communicating between different IPv4 networks in different Autonomous system.

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



Pre-requisite: WAN Interface configuration to be done on the router (LAB – 6)

TASK:

- Configure BGP Routing on IPv4 network
- Verify BGP Routing on IPv4 network
- Verify Communication between the IPv4 networks
- Verify BGP Neighbour and Topology Table on IPv4 networks
- Verify BGP Neighbour Detail

Configure BGP Routing on IPv4 network

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip routing**
CHE (config) # **router bgp 100**
CHE (config-router)# **network 192.168.201.0 mask 255.255.255.0**
CHE (config-router) # **network 172.16.0.0 mask 255.255.0.0**
CHE (config-router) # **neighbor 172.16.0.2 remote-as 200**
CHE (config-router) # **end**
CHE #

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip routing**
HYD-1 (config) # **router bgp 200**
HYD-1 (config-router) # **network 192.168.202.0 mask 255.255.255.0**
HYD-1 (config-router) # **network 172.16.0.0 mask 255.255.0.0**
HYD-1 (config-router) # **network 172.17.0.0 mask 255.255.0.0**
HYD-1 (config-router) # **neighbor 172.16.0.1 remote-as 100**
HYD-1 (config-router) # **neighbor 172.17.0.2 remote-as 300**
HYD-1 (config-router) # **end**
HYD-1 #

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # **ip routing**
BAN (config) # **router bgp 300**
BAN (config-router) # **network 192.168.203.0 mask 255.255.255.0**
BAN (config-router) # **network 172.17.0.0 mask 255.255.0.0**
BAN (config-router) # **neighbor 172.17.0.1 remote-as 200**
BAN (config-router) # **end**
BAN (config) #

Verify BGP Routing

Once BGP routing is enabled, IPv4 Networks learnt via **BGP** are added into the routing table. **"B"** represents **BGP route.**

CHE – Verification:

```
CHE # show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

B    172.17.0.0/16 [20/0] via 172.16.0.2, 00:04:02
C    172.16.0.0/16 is directly connected, Serial0/0
C    192.168.201.0/24 is directly connected, FastEthernet0/0
B    192.168.202.0/24 [20/0] via 172.16.0.2, 00:00:03
B    192.168.203.0/24 [20/0] via 172.16.0.2, 00:02:46
CHE #
```

HYD-1 – Verification:

```
HYD-1 # show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       E1 - OSPF external type 1, E2 - OSPF external type 2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set


     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/16 is directly connected, Serial0/0/1
L       172.16.0.2/32 is directly connected, Serial0/0/1
     172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.17.0.0/16 is directly connected, Serial0/0/0
L       172.17.0.1/32 is directly connected, Serial0/0/0
B    192.168.201.0/24 [20/0] via 172.16.0.1, 00:04:15
     192.168.202.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.202.0/24 is directly connected, FastEthernet0/0
L       192.168.202.1/32 is directly connected, FastEthernet0/0
B    192.168.203.0/24 [20/0] via 172.17.0.2, 00:03:00
HYD-1#
```

BAN – Verification:

BAN # **show ip route**

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    172.17.0.0/16 is directly connected, Serial0/1
B    172.16.0.0/16 [20/0] via 172.17.0.1, 00:03:23
B    192.168.201.0/24 [20/0] via 172.17.0.1, 00:03:23
B    192.168.202.0/24 [20/0] via 172.17.0.1, 00:00:11
C    192.168.203.0/24 is directly connected, FastEthernet0/0
BAN#
```

Verify communication between the IPv4 networks

Verification from a Computer in HYD-1 Network

ping 192.168.201.10

```
PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 192.168.201.10: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=4 ttl=62 time=24.0 ms
```

ping 192.168.203.10

```
PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms
```

Repeat the above ping verification from a computer in CHE and BAN Network.

From a Computer in HYD-1 Network trace communication path to a Computer in CHE Network

```
tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.16.0.1 (172.16.0.1)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

From a Computer in HYD-1 Network trace communication path to a Computer in BAN Network

```
tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1   192.168.202.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   172.17.0.2 (172.17.0.2)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

Repeat the above trace communication path from a computer in CHE and BAN Network.

Verify BGP Neighbour and BGP Table on IPv4 Network

CHE – Verification:

CHE # **show ip bgp summary**

```
BGP router identifier 192.168.201.1, local AS number 100
BGP table version is 6, main routing table version 6
5 network entries and 6 paths using 701 bytes of memory
3 BGP path attribute entries using 180 bytes of memory
2 BGP AS-PATH entries using 48 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP activity 5/0 prefixes, 6/0 paths, scan interval 60 secs

Neighbor     V   AS  MsgRcvd  MsgSent  TblVer  InQ  OutQ  Up/Down  State/PfxRcd
172.16.0.2   4  200   15        12       6      0    0    00:07:40     4
CHE#
```

CHE # **show ip bgp**

```
BGP table version is 6, local router ID is 192.168.201.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal
Origin codes: i - IGP, e - EGP, ? - incomplete

    Network          Next Hop     Metric  LocPrf  Weight  Path
*   172.16.0.0       172.16.0.2     0                 0   200 i
*>                   0.0.0.0        0             32768   i
*>  172.17.0.0       172.16.0.2     0                 0   200 i
*>  192.168.201.0    0.0.0.0        0             32768   i
*>  192.168.202.0    172.16.0.2     0                 0   200 i
*>  192.168.203.0    172.16.0.2     0                 0   200 300 i
CHE#
```

HYD-1 – Verification:

HYD-1 # **show ip bgp summary**
BGP router identifier 192.168.202.1, local AS number 200
BGP table version is 6, main routing table version 6
5 network entries using 680 bytes of memory
7 path entries using 392 bytes of memory
3/3 BGP path/bestpath attribute entries using 384 bytes of memory
2 BGP AS-PATH entries using 48 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 1504 total bytes of memory
BGP activity 5/0 prefixes, 7/0 paths, scan interval 60 secs

Neighbor	V	AS	MsgRcvd	MsgSent	TblVer	InQ	OutQ	Up/Down	State/PfxRcd
172.16.0.1	4	100	11	13	6	0	0	00:06:00	2
172.17.0.2	4	300	9	12	6	0	0	00:05:14	2

HYD-1#

HYD-1 # **show ip bgp**
BGP table version is 6, local router ID is 192.168.202.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale, m multipath, b backup-path, x best-external, f RT-Filter
Origin codes: i - IGP, e - EGP, ? - incomplete

	Network	Next Hop	Metric	LocPrf	Weight	Path
*	172.16.0.0	172.16.0.1	0		0	100 i
*>		0.0.0.0	0		32768	i
*	172.17.0.0	172.17.0.2	0		0	300 i
*>		0.0.0.0	0		32768	i
*>	192.168.201.0	172.16.0.1	0		0	100 i
*>	192.168.202.0	0.0.0.0	0		32768	i
*>	192.168.203.0	172.17.0.2	0		0	300 i

HYD-1#

BAN – Verification:

BAN # **show ip bgp summary**
BGP router identifier 192.168.203.1, local AS number 300
BGP table version is 7, main routing table version 7
5 network entries and 6 paths using 701 bytes of memory
3 BGP path attribute entries using 156 bytes of memory
2 BGP AS-PATH entries using 48 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP activity 5/0 prefixes, 6/0 paths, scan interval 15 secs

Neighbor	V	AS	MsgRcvd	MsgSent	TblVer	InQ	OutQ	Up/Down	State/PfxRcd
172.17.0.1	4	200	12	9	7	0	0	00:05:45	4

BAN#

```
BAN # show ip bgp
BGP table version is 7, local router ID is 192.168.203.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop      Metric  LocPrf  Weight  Path
*> 172.16.0.0       172.17.0.1      0               0     200 i
*> 172.17.0.0       0.0.0.0         0           32768     i
*                   172.17.0.1      0               0     200 i
*> 192.168.201.0    172.17.0.1      0               0     200 100 i
*> 192.168.202.0    172.17.0.1      0               0     200 i
*> 192.168.203.0    0.0.0.0         0           32768     i
BAN#
```

Verify BGP Neighbor Detail

Example - HYD-1

```
HYD-1 # show ip bgp neighbors 172.16.0.1
show ip bgp neighbors 172.16.0.1
BGP neighbor is 172.16.0.1,  remote AS 100, external link
  BGP version 4, remote router ID 192.168.201.1
  BGP state = Established, up for 00:08:30
  Last read 00:00:30, last write 00:00:03, hold time is 180, keepalive interval is 60 seconds
  Neighbor sessions:
    1 active, is not multisession capable (disabled)
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Four-octets ASN Capability: advertised
    Address family IPv4 Unicast: advertised and received
    Multisession Capability:
  Message statistics:
    InQ depth is 0
    OutQ depth is 0
!
<output omitted>
!
Datagrams (max data segment is 1460 bytes):
Rcvd: 25 (out of order: 0), with data: 12, total data bytes: 309
Sent: 27 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0), with data: 15,
total data bytes: 438
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

HYD-1 #
```

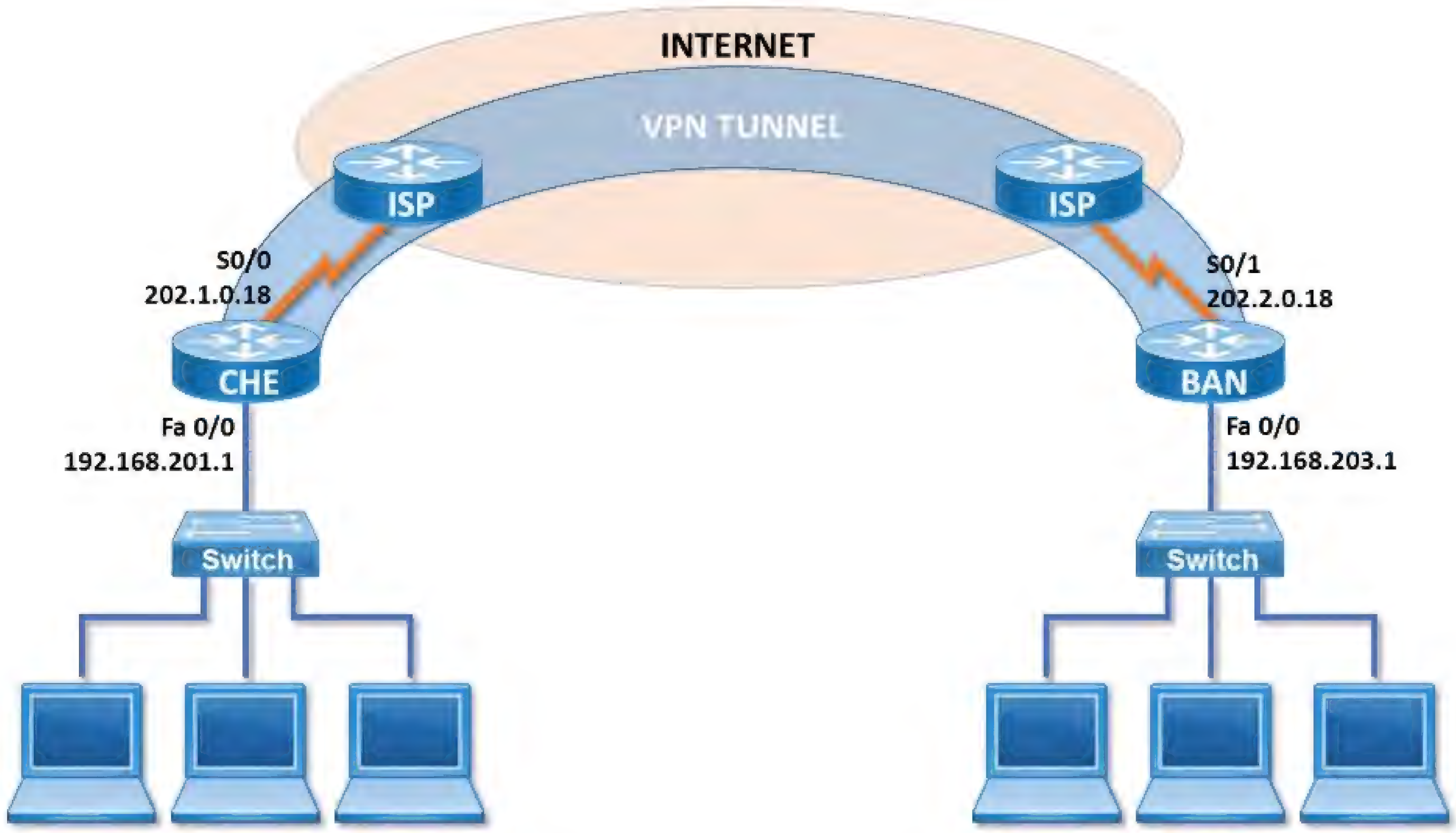
LAB 41: GENERIC ROUTING ENCAPSULATION (GRE)

OBJECTIVE:

To set up a GRE VPN to enable communication between different networks .

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	202.1.0.16/29

Interface	Network ID / Mask
Fa 0/0	192.168.203.0/24
S 0/0	202.2.0.16/29

TASK:

- Configure Serial Interface
- Configure Default Routing
- Configure GRE Tunnel Interface
- Verify GRE Tunnel Configuration
- Configure Routing
- Verify Routing
- Verify communication between the networks

Configure Serial Interface

CHE – Configuration

CHE (config) # **interface serial 0/0**
CHE (config-if) # **ip address 202.1.0.18 255.255.255.248**
CHE (config-if) # **no shutdown**
CHE (config-if) # **encapsulation ppp**
CHE (config-if) # **exit**
CHE (config) #

BAN – Configuration

BAN (config) # **interface serial 0/1**
BAN (config-if) # **ip address 202.2.0.18 255.255.255.248**
BAN (config-if) # **no shutdown**
BAN (config-if) # **encapsulation ppp**
BAN (config-if) # **exit**
BAN (config) #

Configure Default Routing

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip route 0.0.0.0 0.0.0.0 Serial0/0**
CHE (config) # **exit**
CHE #

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # **ip route 0.0.0.0 0.0.0.0 Serial0/1**
BAN (config) # **exit**
BAN #

Configure GRE Tunnel Interface

CHE – Configuration

CHE (config) # **int tunnel 0**
CHE (config-if) # **ip add 1.1.1.1 255.255.255.0**
CHE (config-if) # **tunnel mode gre ip**
CHE (config-if) # **tunnel source serial 0/0**
CHE (config-if) # **tunnel destination 202.2.0.18**
CHE (config-if) # **end**
CHE #

BAN – Configuration

BAN (config) # **int tunnel 0**
BAN (config-if)# **ip add 1.1.1.2 255.255.255.0**
CHE (config-if) # **tunnel mode gre ip**
BAN (config-if)# **tunnel source serial 0/1**
BAN (config-if)# **tunnel destination 202.1.0.18**
BAN (config-if)# **end**
BAN #

Verify GRE Tunnel Configuration

CHE – Verification

CHE # **show ip interface brief tunnel 0**

Interface	IP-Address	OK?	Method	Status	Protocol
Tunnel0	1.1.1.1	YES	manual	up	up

CHE #

CHE # **sh int tunnel 0**

```
Tunnel0 is up, line protocol is up
  Hardware is Tunnel
Internet address is 1.1.1.1/24
  MTU 1514 bytes, BW 9 Kbit, DLY 500000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
Encapsulation TUNNEL, loopback not set
  Keepalive set (10 sec)
Tunnel source 202.1.0.18 (Serial0/0), destination 202.2.0.18
  Tunnel protocol/transport GRE/IP, key disabled, sequencing disabled
  Checksumming of packets disabled,  fast tunneling enabled
  !
<output omitted>
  !
CHE#
```

BAN – Verification

BAN # **show ip interface brief tunnel 0**

Interface	IP-Address	OK?	Method	Status	Protocol
Tunnel0	1.1.1.1	YES	manual	up	up

BAN #

BAN # **sh int tunnel 0**
Tunnel0 is up, line protocol is up
 Hardware is Tunnel
Internet address is 1.1.1.2/24
 MTU 1514 bytes, BW 9 Kbit, DLY 500000 usec,
  reliability 255/255, txload 1/255, rxload 1/255
Encapsulation TUNNEL, loopback not set
 Keepalive set (10 sec)
Tunnel source 202.2.0.18 (Serial0/1), destination 202.1.0.18
 Tunnel protocol/transport GRE/IP, key disabled, sequencing disabled
 Checksumming of packets disabled, fast tunneling enabled
 !
<output omitted>
 !
BAN #

Configure Routing

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip route 192.168.203.0 255.255.255.0 tunnel 0**
CHE (config) #

BAN – Configuration

BAN # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
BAN (config) # **ip routing**
CHE (config) # **ip route 192.168.201.0 255.255.255.0 tunnel 0**
BAN (config) #

Verify Routing

CHE – Verification:

CHE # **show ip route**
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route

Gateway of last resort is not set

C 172.16.0.0/16 is directly connected, Serial0/0
C 192.168.201.0/24 is directly connected, FastEthernet0/0
S 192.168.203.0/24 [1/0] directly connected, Tunnel0
S* 0.0.0.0/0 [1/0] via Serial0/0

CHE #

BAN – Verification:

BAN # **show ip route**
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route

Gateway of last resort is not set

C 172.16.0.0/16 is directly connected, Serial0/1
C 192.168.203.0/24 is directly connected, FastEthernet0/0
S 192.168.201.0/24 [1/0] directly connected, Tunnel0
S* 0.0.0.0/0 [1/0] via Serial0/1

BAN #

Verify communication between the networks

Verification from a Computer in CHE Network by pinging a computer in the BAN network

ping 192.168.203.10

PING 192.168.203.10 (192.168.203.10) 56(84) bytes of data.
64 bytes from 192.168.203.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.203.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.203.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.203.10: icmp_seq=29 ttl=62 time=24.2 ms

Verification from a Computer in BAN Network by pinging a computer in the CHE network

ping 192.168.201.10

PING 192.168.201.10 (192.168.201.10) 56(84) bytes of data.
64 bytes from 192.168.201.10: icmp_seq=25 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=26 ttl=62 time=24.1 ms
64 bytes from 192.168.201.10: icmp_seq=27 ttl=62 time=24.3 ms
64 bytes from 192.168.201.10: icmp_seq=28 ttl=62 time=24.2 ms
64 bytes from 192.168.201.10: icmp_seq=29 ttl=62 time=24.2 ms

From a Computer in CHE Network trace communication path to a Computer in BAN Network

tracert 192.168.203.10 (Windows) or traceroute 192.168.203.10 (Linux)

```
traceroute to 192.168.203.10 (192.168.203.10), 30 hops max, 38 byte packets
 1   192.168.201.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   1.1.1.1 (1.1.1.1)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.203.10 (192.168.203.10)  3.295 ms  3.156 ms  3.209 ms
```

From a Computer in BAN Network trace communication path to a Computer in CHE Network

tracert 192.168.201.10 (Windows) or traceroute 192.168.201.10 (Linux)

```
traceroute to 192.168.201.10 (192.168.201.10), 30 hops max, 38 byte packets
 1   192.168.203.1 (192.168.202.1)  1.086 ms  1.124 ms  1.144 ms
 2   1.1.1.2 (1.1.1.2)  2.295 ms  2.156 ms  2.209 ms
 3   192.168.201.10 (192.168.202.10)  3.295 ms  3.156 ms  3.209 ms
```

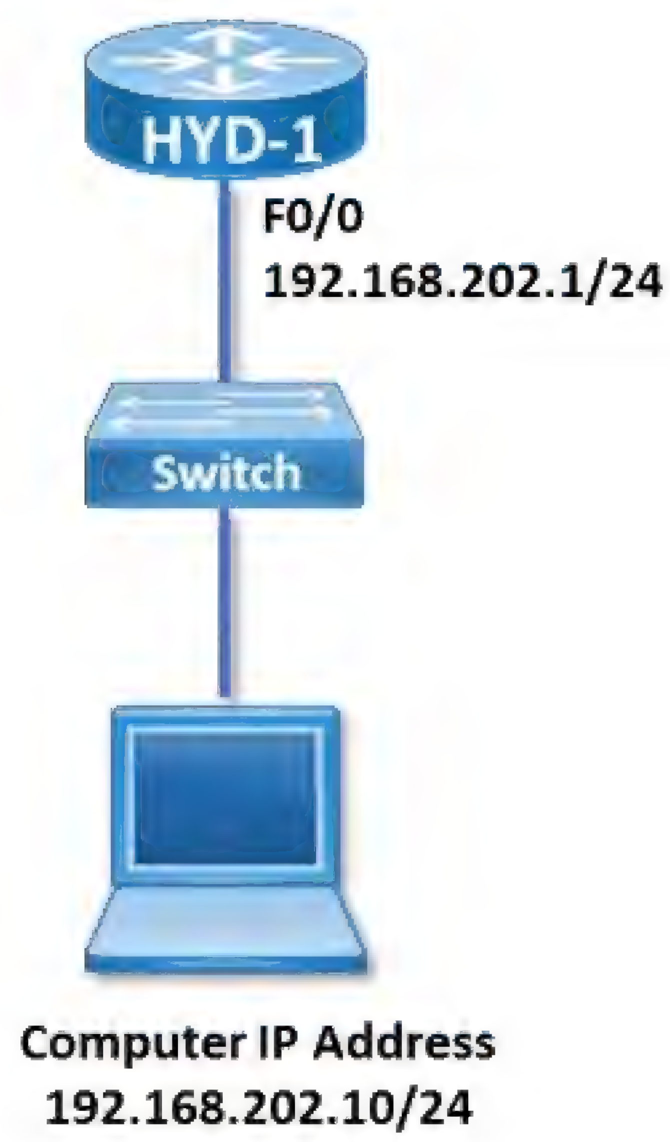
LAB 42 : ENHANCING ROUTER SECURITY

OBJECTIVE:

To enhance router security by authentication and enabling ssh access on router.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Pre-requisite: 192.168.202.10 computer should have Radius Server software installed and running.

TASK:

- Configure Local Authentication
- Verify Local Authetication
- Configure AAA Authentication (Radius Server)
- Verify AAA Authentication
- Configure the SSH Server on Router
- Verify SSH access to Router

Configure Local Authentication

Example - HYD-1

Configure a new user with password

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **username zoom password cisco**
HYD-1 (config) #

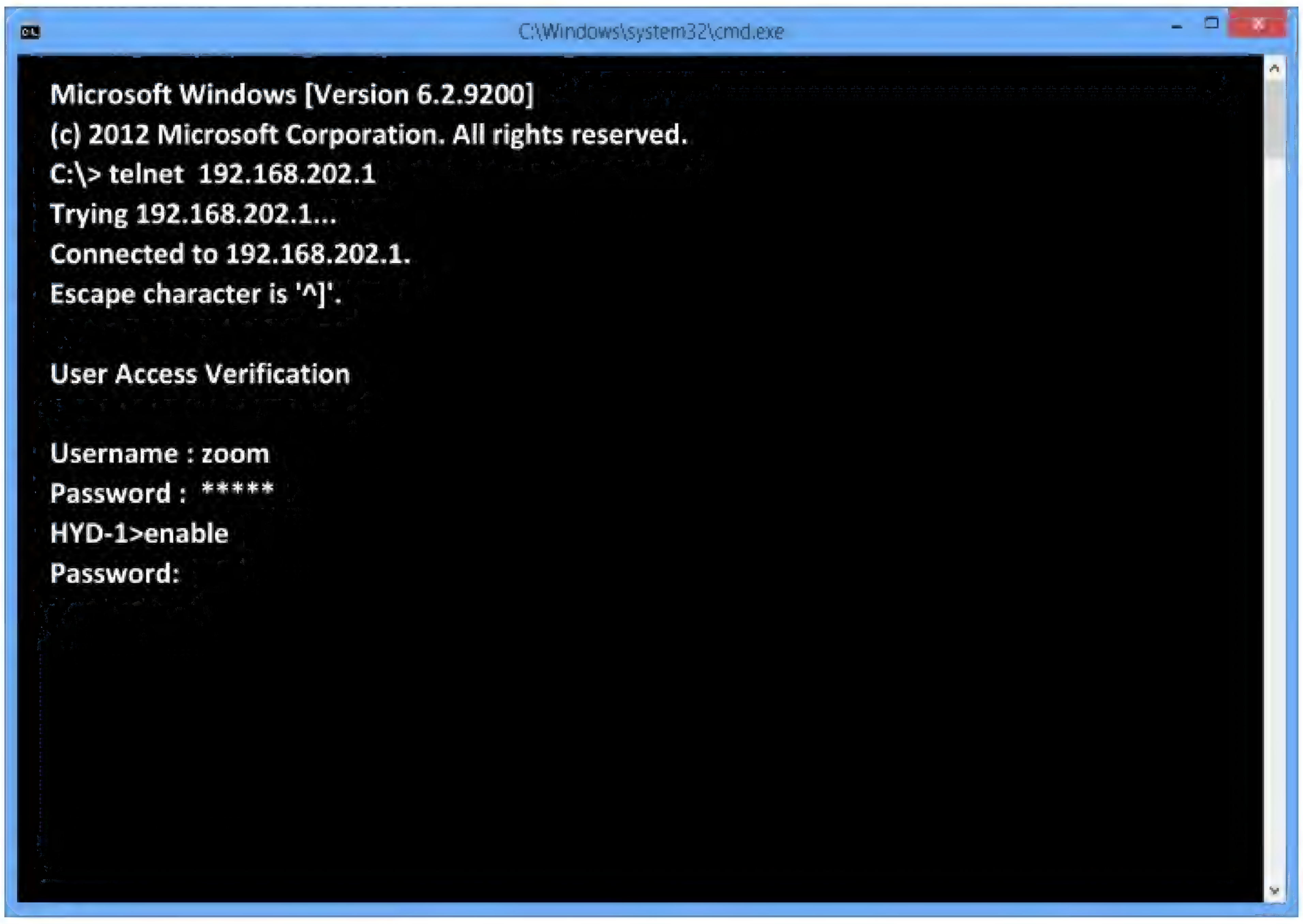
Enabling userwise access for VTY session

HYD-1 (config) # **line vty 0 4**
HYD-1 (config-line) # **login local**
HYD-1 (config-line) # **end**

Verify Local Authentication

Now open a new telnet session from your computer to the router and try to login using already configured user.

i.e. **telnet 192.168.202.1**



Configure AAA Authentication (Radius Server)

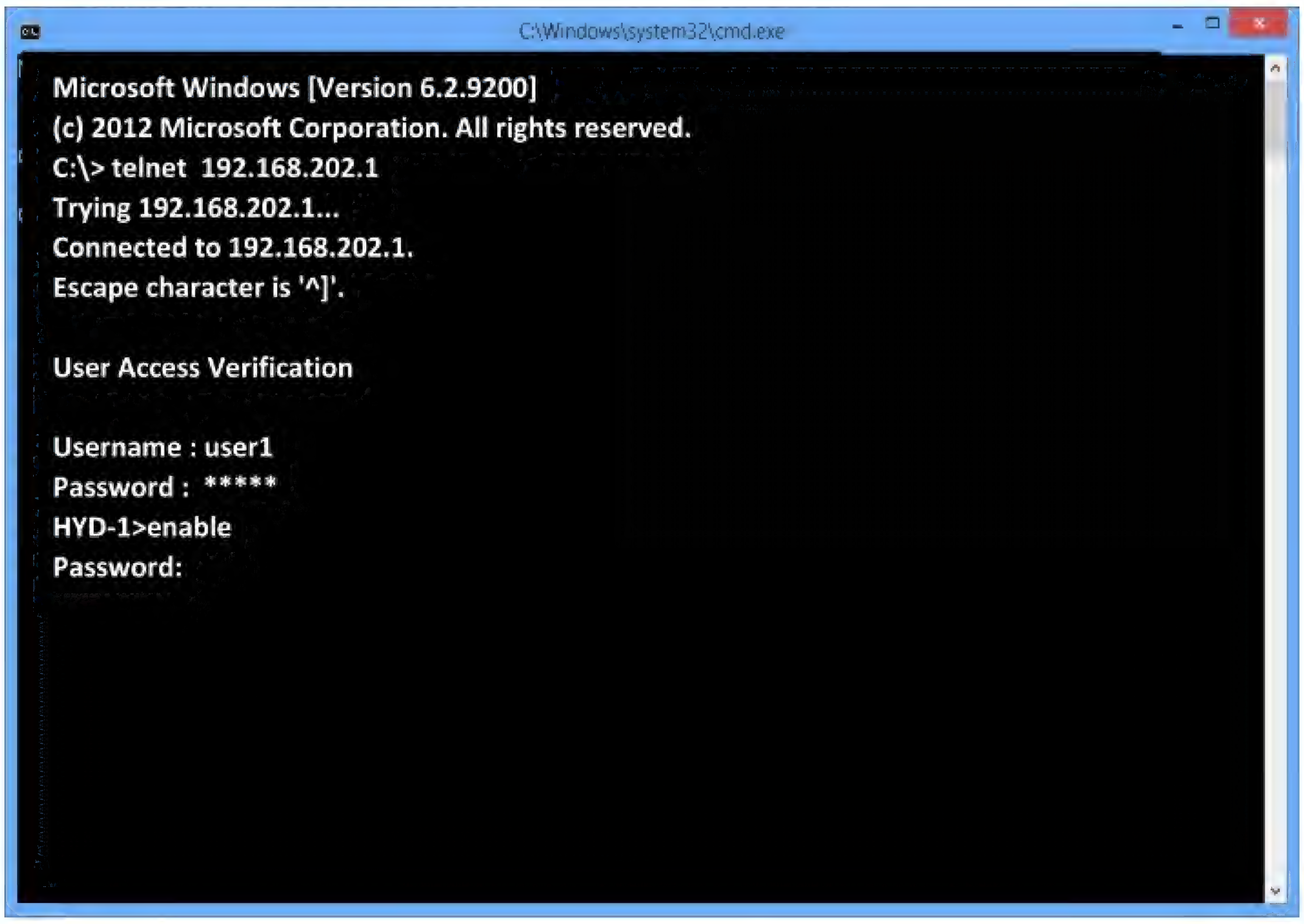
Example - HYD-1

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **aaa new-model**
HYD-1 (config) # **radius-server host 192.168.202.10 key cisco**
HYD-1 (config) # **aaa authentication login default group radius local**

Verify AAA Authentication

Create New User on Radius Server. Try to login using newly created user by opening a new telnet session from your computer to the router.

i.e. **telnet 192.168.202.1**



Configure the SSH Server on Router

Configure a domain name

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip domain-name zoom.com**

Configure the vty lines.
HYD-1 (config) # **line vty 0 4**
HYD-1 (config-line) # **login local**
HYD-1 (config-line) # **transport input ssh**
HYD-1 (config-line) # **exit**

Generate the RSA encryption key pair for the router

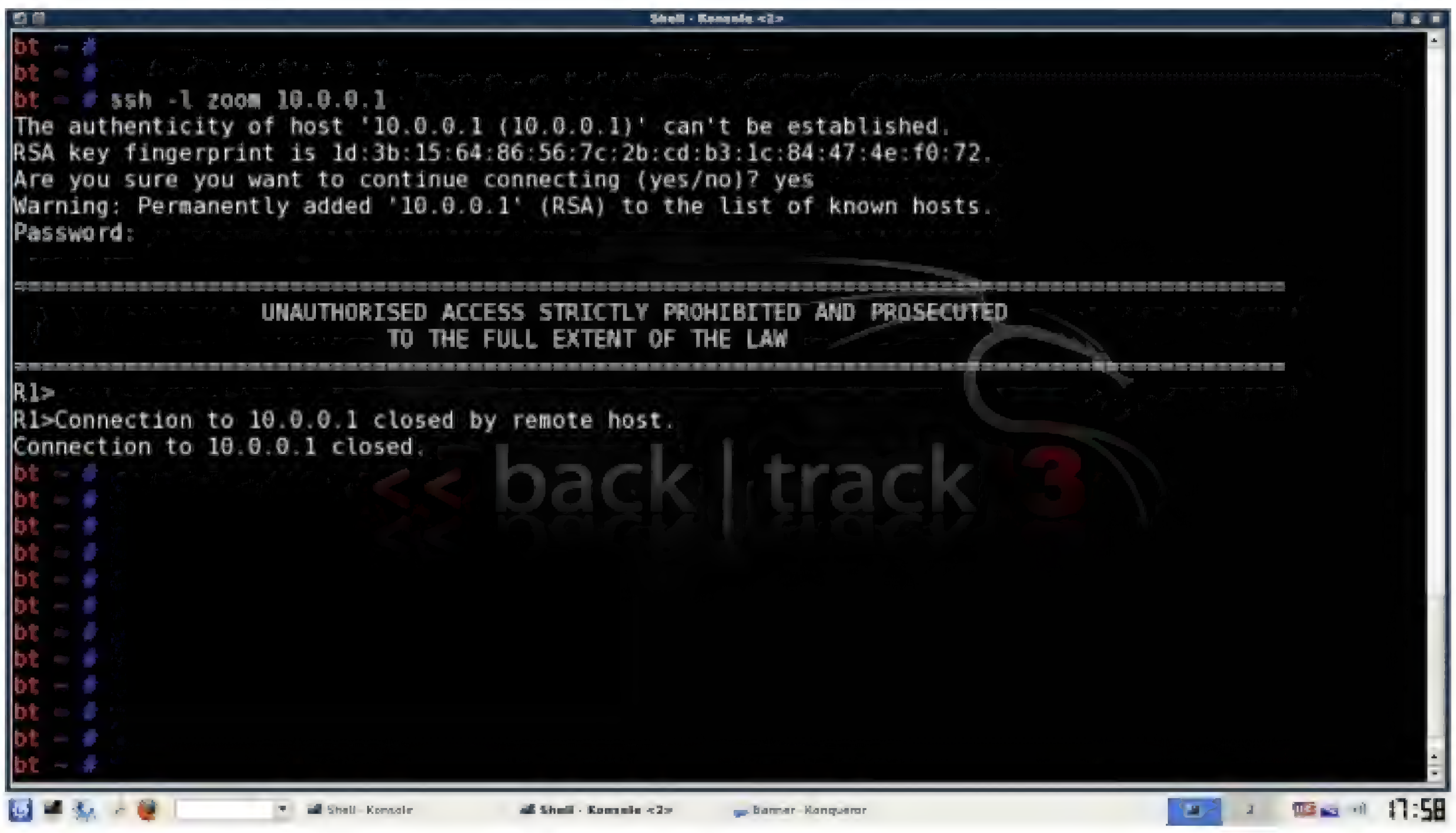
HYD-1 (config) # **crypto key generate rsa**
The name for the keys will be: HYD-1.zoom.com
Choose the size of the key modulus in the range of 360 to 2048 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take a few minutes.

How many bits in the modulus [512]: **1024**
% Generating 1024 bit RSA keys, keys will be non-exportable...
[OK] (elapsed time was 3 seconds)
R1 (config)# **end**
R1 #

Verify SSH access to Router

Now open a new telnet session from your computer to the router, you will not able to access router via telnet.
Verify SSH access to HYD-1 from computer by giving below command :

ssh -l zoom 192.168.202.1



LAB 43: DHCP SERVER AND CLIENT

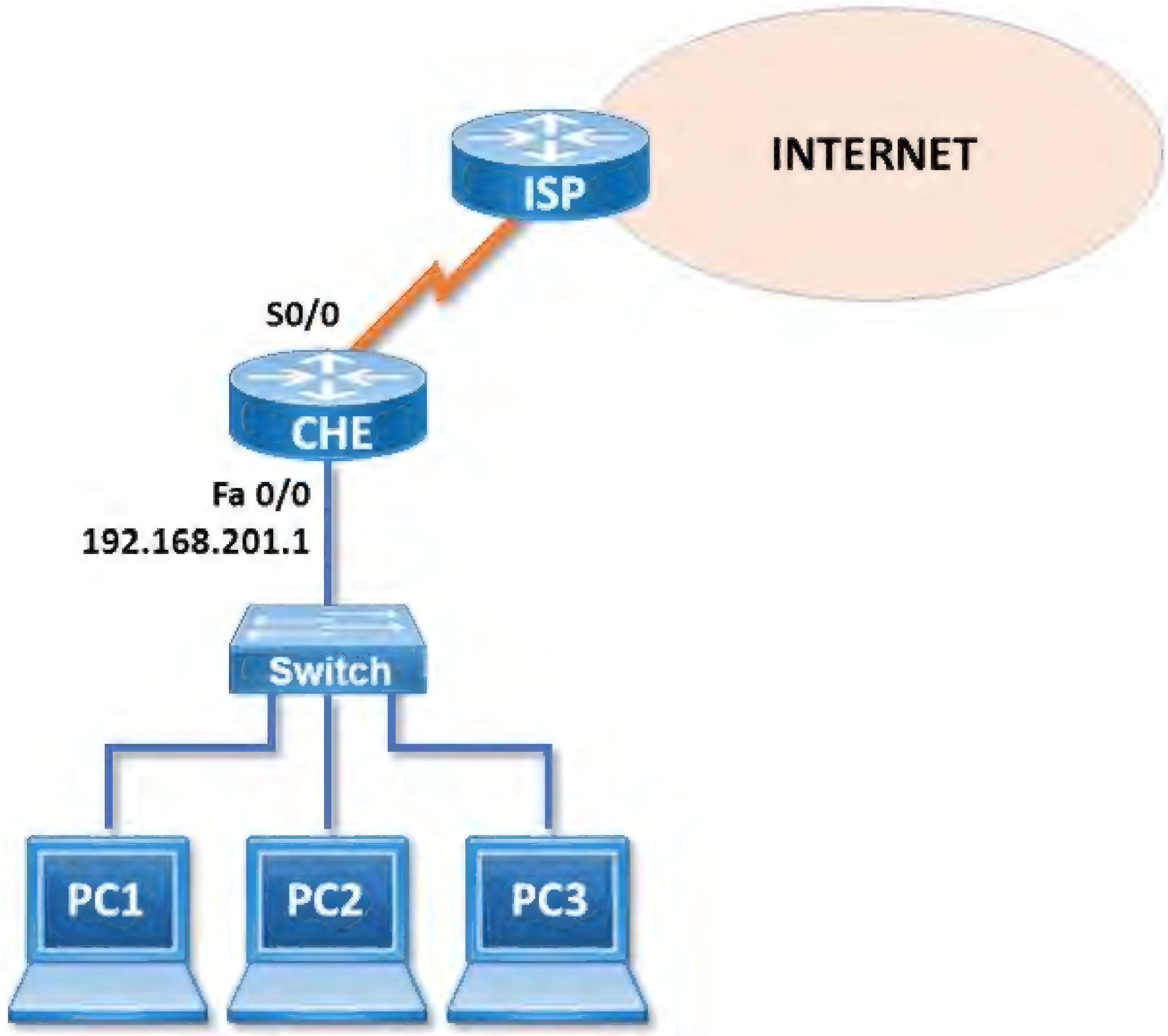
OBJECTIVE:

To configure a Router as a DHCP Server for assigning IP addresses, DNS, gateway, etc. to client computers.

To configure an interface of Router as a DHCP Client for getting IP addresses from ISP.

TOPOLOGY:

Setup the router for the lab as below:



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24

TASK:

- Configure Router as DHCP Server
- Verify DHCP on client computer
- Verify DHCP Server
- Configure an interface of a Router as DHCP Client
- Verify DHCP Client

Configure Router as DHCP Server

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **ip dhcp pool zoom**
CHE (dhcp-config) # **network 192.168.201.0 255.0.0.0**
CHE (dhcp-config) # **default-router 192.168.201.1**
CHE (dhcp-config) # **dns-server 8.8.8.8**
CHE (dhcp-config) # **lease 1 1 1**
CHE (dhcp-config) # **exit**
CHE (config) # **ip dhcp excluded-address 192.168.201.1 192.168.201.50**
CHE (config)# **exit**

Verify DHCP on client computer

On Windows Computer, Select **Obtain IP Address Automatically** in Network Properties and verify the dhcp ip address by giving **ipconfig** command on command prompt.

On Linux Computer give below commands

 # dhclient
Internet Systems Consortium DHCP Client V3.0.6
Copyright 2004-2007 Internet Systems Consortium.
Sending on   LPF/eth0/00:1b:b9:9a:16:8d
Sending on   Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 8
DHCPOFFER from 192.168.201.5
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 192.168.201.5
bound to 192.168.201.5 -- renewal in 40650 seconds.

 # ifconfig
eth0 Link encap:Ethernet HWaddr 00:1B:B9:9A:16:8D
inet addr:192.168.201.5 Bcast:92.168.201.255 Mask:255.0.0.0
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:9263 errors:0 dropped:0 overruns:0 frame:0

Verify DHCP Server

CHE – Verification:

```
CHE # show ip dhcp binding
Bindings from all pools not associated with VRF:
IP address          Client-ID/              Lease expiration          Type
                    Hardware address/
                    User name
192.168.202.5    001c.c06c.91f3      Aug 27 2016 02:21 PM   Automatic
192.168.202.10 001b.b99a.168d      Aug 27 2016 02:25 PM   Automatic
CHE #
```

Configure an interface of a Router as DHCP Client

CHE – Configuration

```
CHE # configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
CHE (config)# interface serial 0/0
CHE (config-if)# ip address dhcp
CHE (config-if)# no shutdown
CHE (config-if)# exit
CHE (config)#
```

Verify DHCP Client

```
CHE # show interface serial 0/0
Serial0/0 is up, line protocol is up
  Hardware is PowerQUICC Serial
Internet address is 202.1.0.18/29
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set
  Keepalive set (10 sec)
  !
<output omitted>
  !

CHE  #
```

```
CHE # show ip interface brief
Interface              IP-Address      OK? Method Status                  Protocol
FastEthernet0/0        192.168.202.1   YES  NVRAM  up                      up
Serial0/0/0            202.1.0.18      YES  DHCP   up                      up
Serial0/0/1              unassigned    YES  manual  administratively down  down

CHE #
```

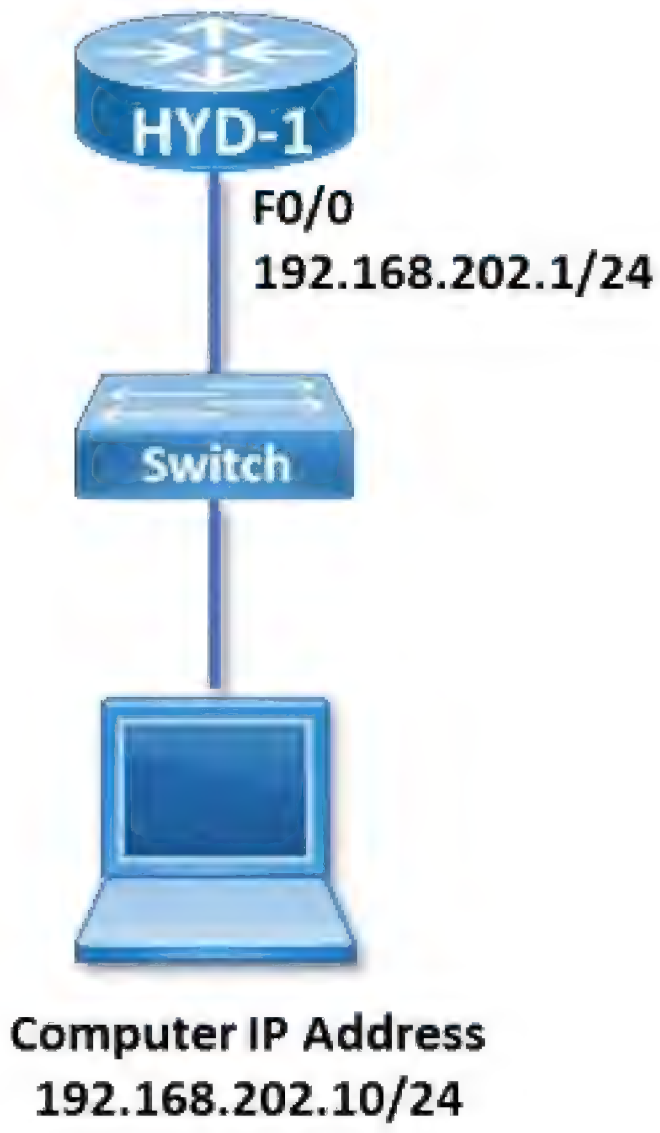
LAB 44: SNMP

OBJECTIVE:

To configure router as SNMP Agent and sending snmp traps to a SNMP server.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Pre-requisite: 192.168.202.10 computer should have SNMP server software installed and running.

TASK:

- Configure Router as SNMP Agent
- Generate and Verify SNMP Traps

Configure Router as SNMP Agent

HYD-1 – Configuration

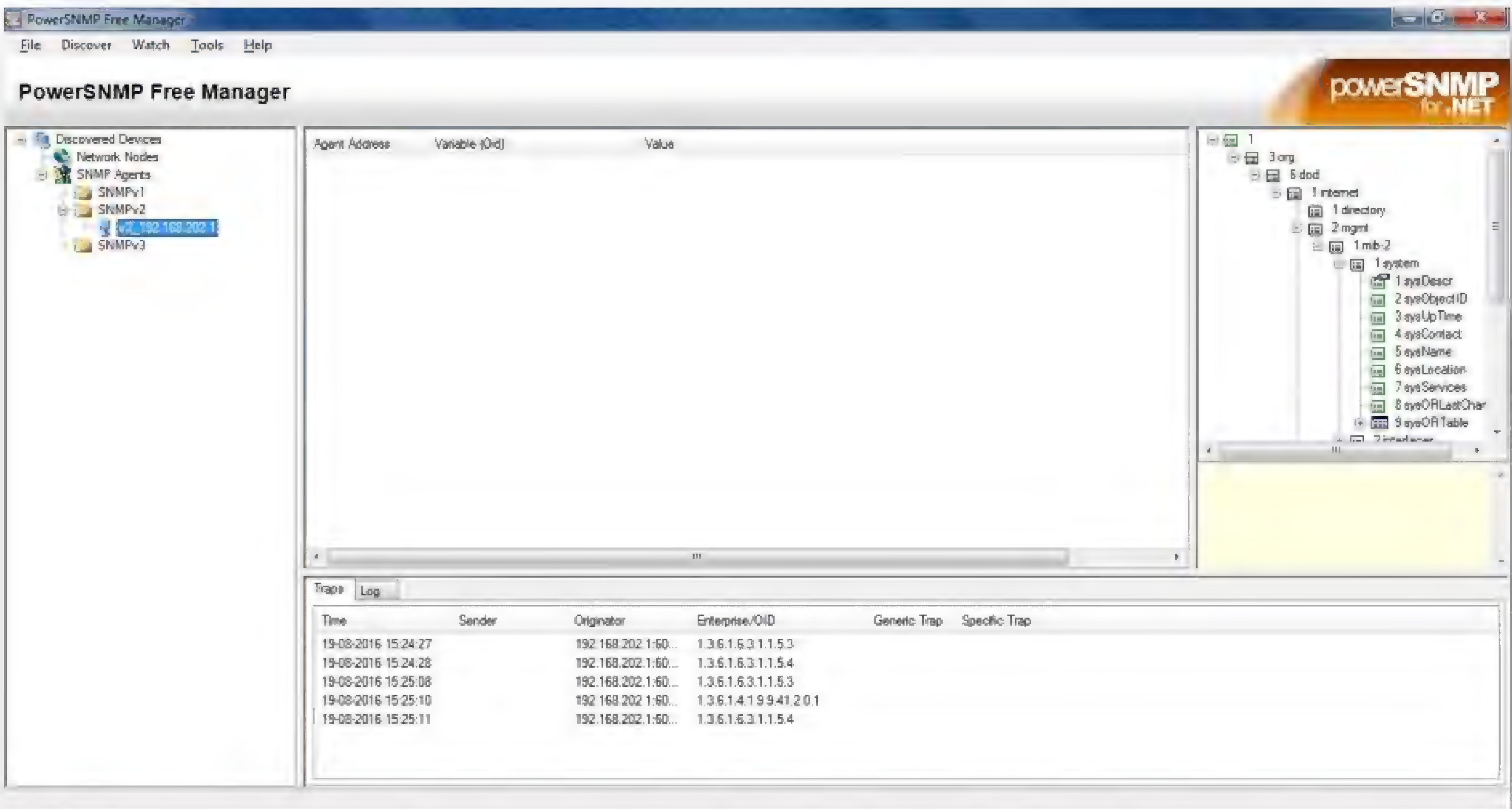
HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **snmp-server community public rw**
HYD-1 (config) # **snmp-server host 192.168.202.10 version 2c public**
HYD-1 (config) # **snmp-server enable traps**
HYD-1 (config) # **exit**
HYD-1 #

Generate and Verify SNMP Traps

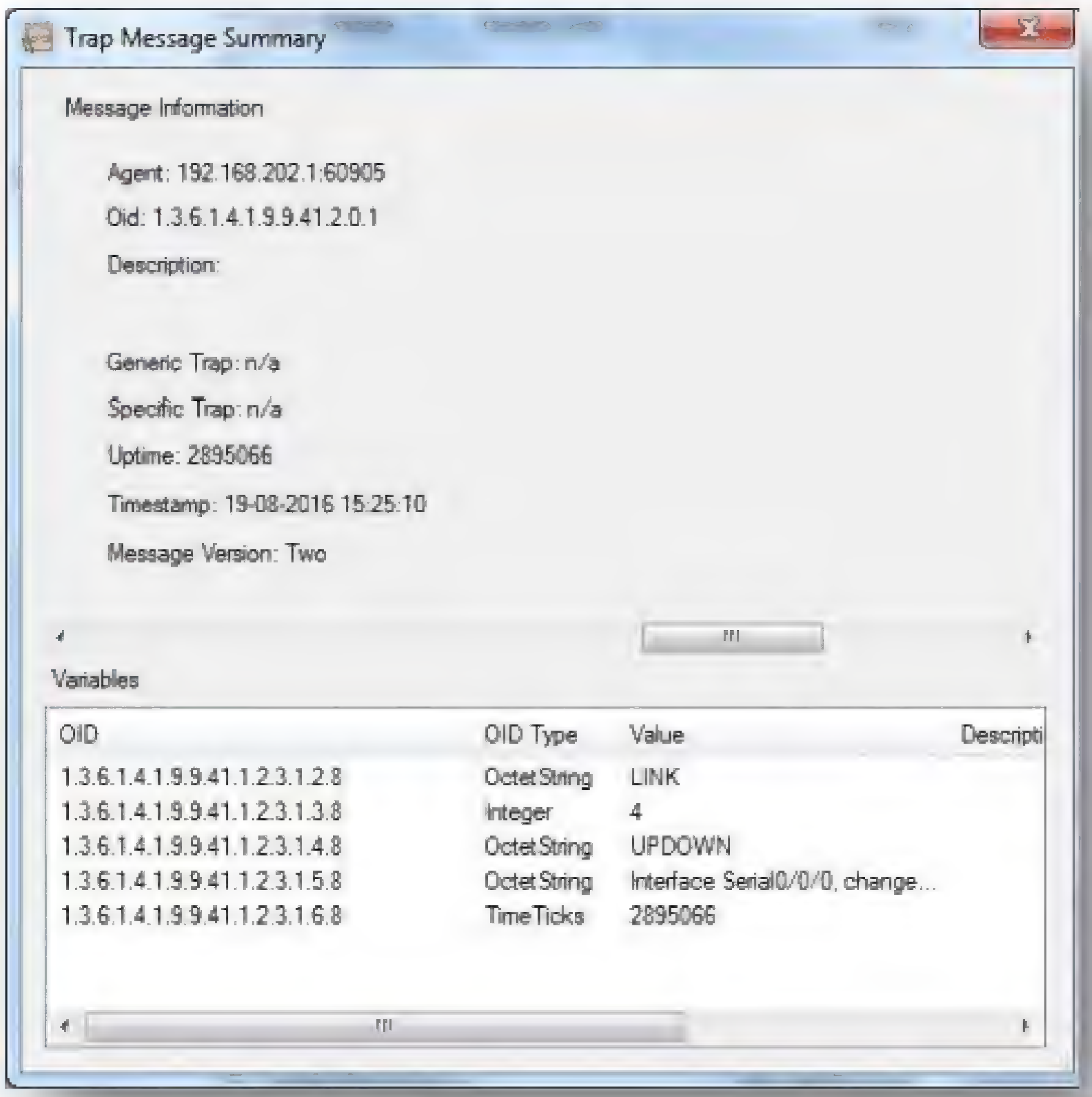
HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **interface serial 0/0/0**
HYD-1 (config-if) # **shutdown**
HYD-1 (config-if) # **no shutdown**
HYD-1 (config-if) # **end**
HYD-1 #

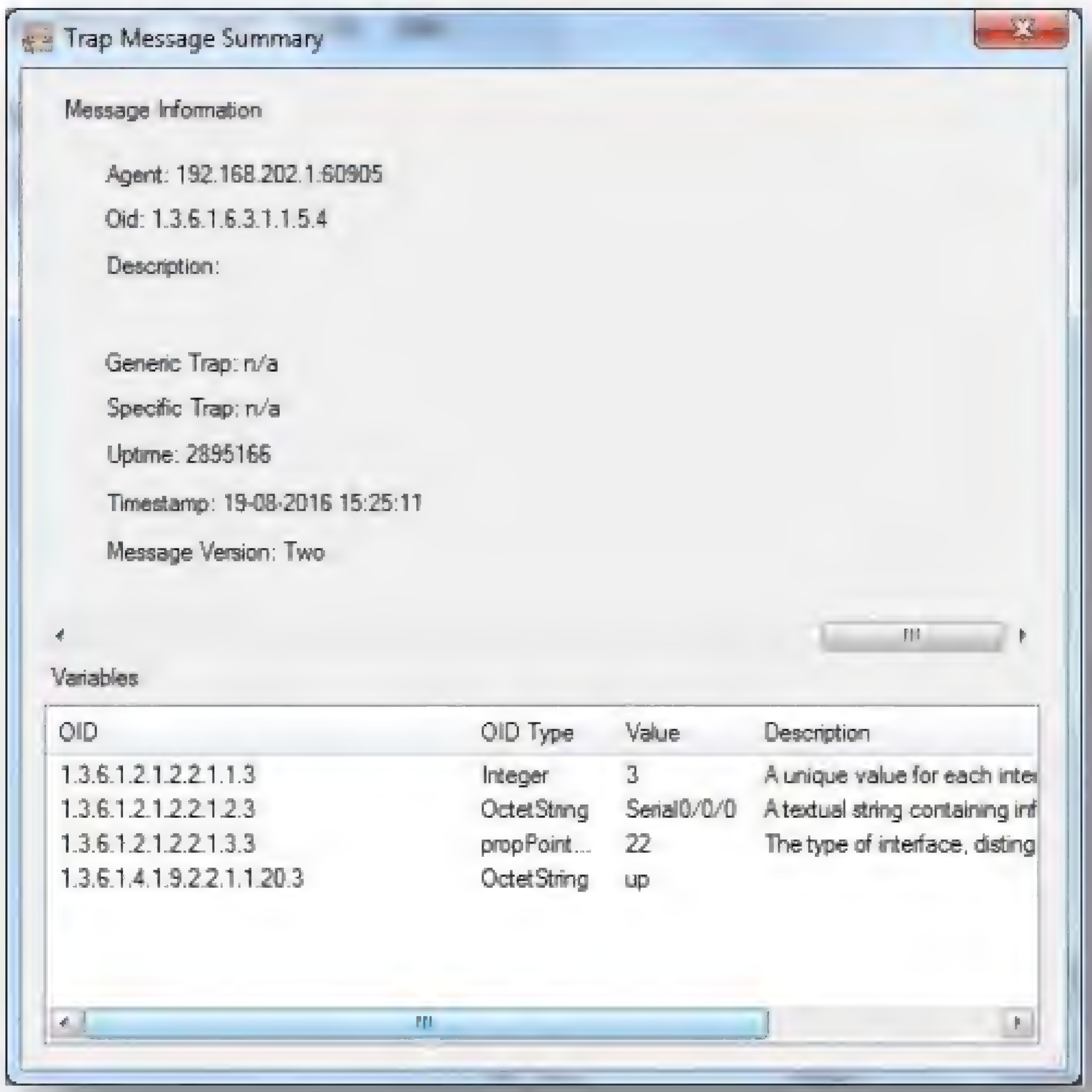
Verification on SNMP Server (PC) :

Start **SNMP software** to view the SNMP traps as below :



Below screenshot of SNMP trap gives detailed information of change in Interface status :





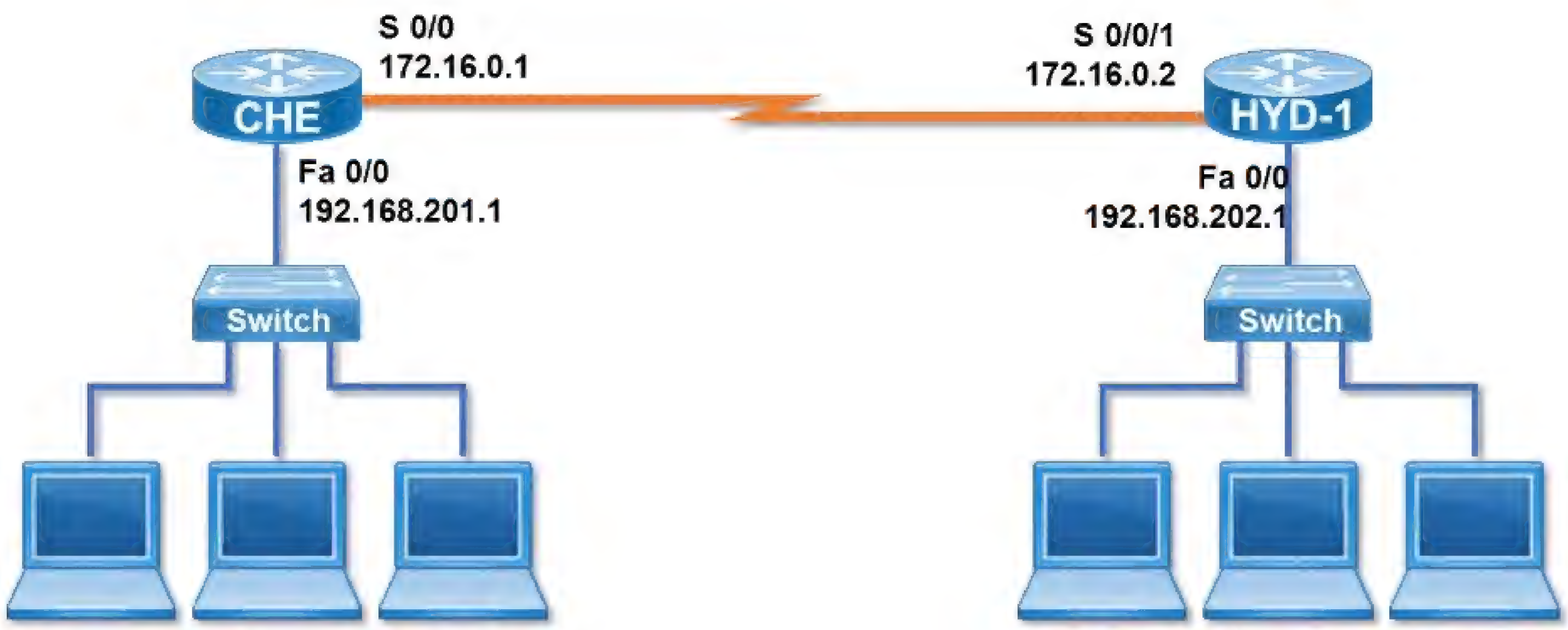
LAB 45: PPP AUTHENTICATION

OBJECTIVE:

To enable PPP authentication between routers

TOPOLOGY:

Setup Ethernet and Serial connectivity for the lab as below:



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	172.16.0.0/16

Interface	Network ID / Mask
Fa 0/0	192.168.202.0/24
S 0/0/1	172.16.0.0/16

TASK:

- Configure Serial Interface
- Verify Serial Interface Configuration
- Configure PPP Authentication (CHAP)
- Verify Serial Interface set up
- Troubleshoot PPP Authentication

Configure Serial Interface

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config)# **interface serial 0/0**
CHE (config-if)# **ip address 172.16.0.1 255.255.0.0**
CHE (config-if)# **no shutdown**
CHE (config-if)# **clock rate 64000**
CHE (config-if)# **encapsulation ppp**
CHE (config-if)# **exit**
CHE (config)#

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config)# **interface serial 0/0/1**
HYD-1 (config-if)# **ip address 172.16.0.2 255.255.0.0**
HYD-1 (config-if)# **no shutdown**
HYD-1 (config-if)# **encapsulation ppp**
HYD-1 (config-if)# **exit**
HYD-1 (config)# **exit**

Verify Serial Interface Configuration

CHE – Verification

CHE # **show interface serial 0/0**
Serial0/0 is up, line protocol is up
  Hardware is PowerQUICC Serial
Internet address is 172.16.0.1/16
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP, loopback not set
  Keepalive set (10 sec)
  LCP Open
  Open: IPCP, CDPCP
  !
<output omitted>
  !
CHE #

HYD-1 – Verification:

HYD-1 # **show interface serial 0/0/1**
Serial0/0/1 is up, line protocol is up
 Hardware is GT96K Serial
Internet address is 172.16.0.2/16
 MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
  reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP, loopback not set
 Keepalive set (10 sec)
 LCP Open
 Open: IPCP, CDPCP
 !
<output omitted>
 !
HYD-1 #

Configure PPP Authentication (CHAP)

CHE – Configuration

CHE # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
CHE (config) # **username HYD-1 password cisco**
CHE (config) # **interface serial 0/0**
CHE (config-if) # **ppp authentication chap**
CHE (config-if) # **end**
CHE #

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **username CHE password cisco**
HYD-1 (config) # **interface serial 0/0/1**
HYD-1 (config-if) # **ppp authentication chap**
HYD-1 (config-if) # **end**
HYD-1 #

Verify Serial Interface

CHE – Verification

CHE # **show interface serial 0/0**
Serial0/0 is up, line protocol is up
 Hardware is PowerQUICC Serial
 Internet address is 172.16.0.1/16
 MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
  reliability 240/255, txload 1/255, rxload 1/255

Encapsulation PPP, loopback not set
 Keepalive set (10 sec)
LCP Open
Open: IPCP, CDPCP
 !
<output omitted>
 !
CHE #

HYD-1 – Verification:

HYD-1 # **show interface serial 0/0/1**
Serial0/0/1 is up, line protocol is up
 Hardware is GT96K Serial
Internet address is 172.16.0.2/16
 MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
 reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP, loopback not set
 Keepalive set (10 sec)
LCP Open
 Open: IPCP, CDPCP
 !
<output omitted>
 !
HYD-1 #

Troubleshooting PPP Authentication

After enabling PPP authentication, if you see the following output means, it means there is a problem with authentication configuration.

CHE # **show interface serial 0/0**
Serial0/0 is up, line protocol is down
 Hardware is PowerQUICC Serial
 Internet address is 172.16.0.1/16
 MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
 reliability 246/255, txload 1/255, rxload 1/255
Encapsulation PPP, loopback not set
 Keepalive set (10 sec)
LCP TERMsent
 Closed: IPCP, CDPCP
 !
<output omitted>
 !
CHE #

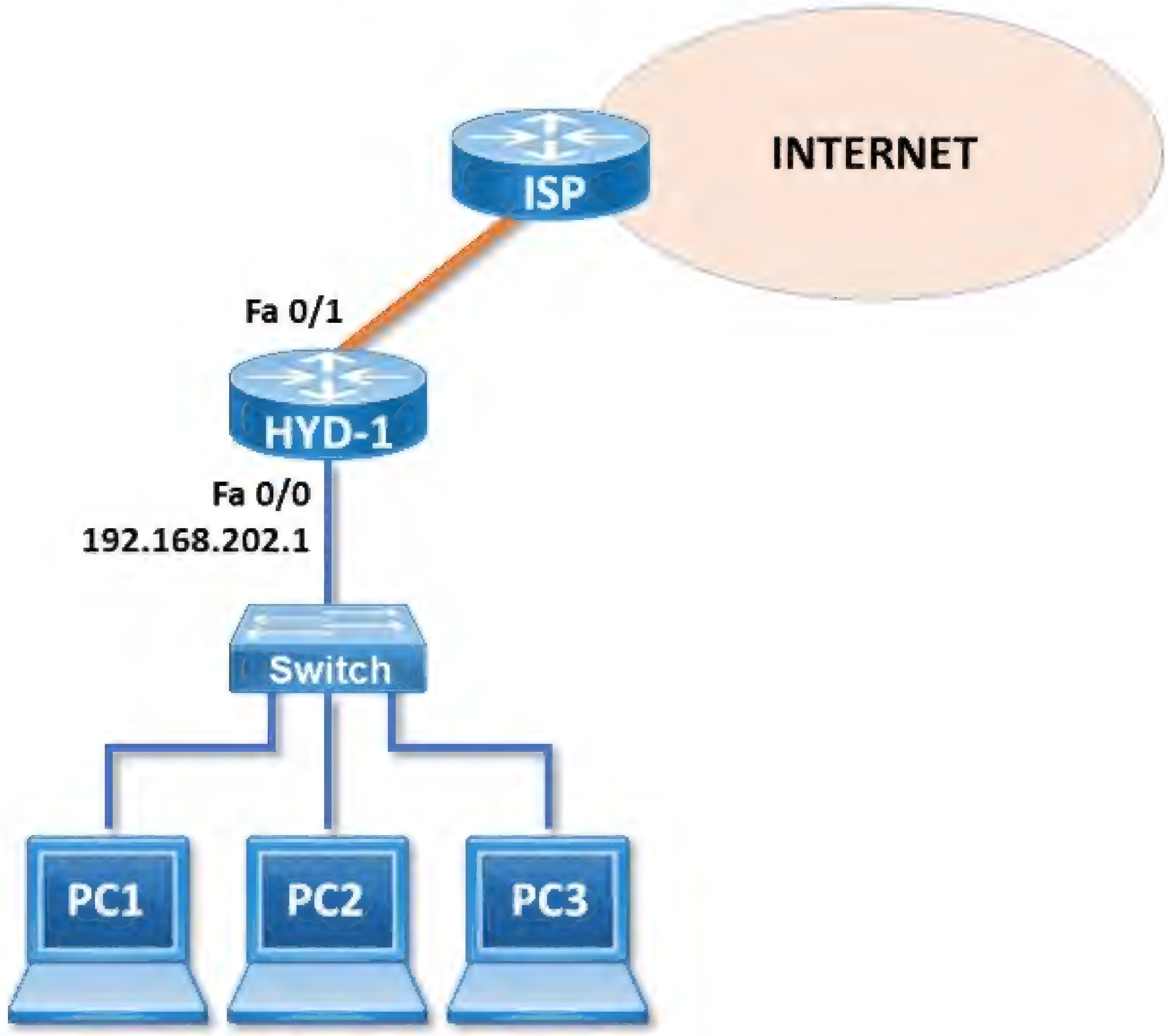
LAB 46: Point-to-Point Protocol over Ethernet (PPPoE)

OBJECTIVE:

To configure PPPOE client for accessing Internet.

TOPOLOGY:

Setup Ethernet connectivity for the lab as below :



Interface	Network ID / Mask
Fa 0/0	192.168.202.0/24

TASK:

- Configure PPPoE Client on Ethernet Interface
- Verify PPPoE Client
- Verify communication from LAN to the Internet

Configure PPPoE on Ethernet Interface

Configure PPPoE on Ethernet Interface to get authenticated by ISP. After successful authentication IP addresses and default route are provided by ISP

HYD-1 – Configuration

HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **interface fastethernet 0/1**
HYD-1 (config-if) # **no ip address**
HYD-1 (config-if) # **pppoe enable**
HYD-1 (config-if) # **pppoe-client dial-pool-number 1**
HYD-1 (config-if) # **exit**
HYD-1 (config) # **interface dialer 1**
HYD-1 (config-if) # **mtu 1492**
HYD-1 (config-if) # **ip address negotiated**
HYD-1 (config-if) # **encapsulation ppp**
HYD-1 (config-if) # **ppp authentication pap callin**
HYD-1 (config-if) # **ppp pap sent-username cisco password ccna**
HYD-1 (config-if) # **dialer pool 1**
HYD-1 (config-if) # **ppp ipcp route default**
HYD-1 (config-if) # **end**
HYD-1 #

Verify PPPoE Client

HYD-1 – Verification:

HYD-1 # **show interfaces dialer 1**

```
Dialer1 is up, line protocol is up (spoofing)
  Hardware is Unknown
  Internet address is 202.1.0.18/32
  MTU 1492 bytes, BW 56 Kbit/sec, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Closed, loopback not set
  Keepalive set (10 sec)
  DTR is pulsed for 1 seconds on reset
  Interface is bound to Vi2
  Last input never, output never, output hang never
  Last clearing of "show interface" counters 00:04:10
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/0/16 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 42 kilobits/sec
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
```

```
    4 packets input, 56 bytes
    10 packets output, 548 bytes
Bound to:
Virtual-Access2 is up, line protocol is up
  Hardware is Virtual Access interface
  MTU 1492 bytes, BW 56 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Stopped: CDPCP
  Open: IPCP
  PPPoE vaccess, cloned from Dialer1
  Vaccess status 0x44, loopback not set
  Keepalive set (10 sec)
   !
   <output omitted>
   !
    0 output buffer failures, 0 output buffers swapped out
    0 carrier transitions
HYD-1#
```

HYD-1 # **show ip interface brief**

```
Interface          IP-Address      OK? Method Status                Protocol
FastEthernet0/0    192.168.201.1   YES NVRAM  up                    up
FastEthernet0/1    unassigned      YES manual up                    up
Serial0/0/0        unassigned      YES manual administratively down down
Serial0/0/1        unassigned      YES manual administratively down down
Dialer1            202.1.0.18      YES IPCP   up                    up
Virtual-Access1    unassigned      YES unset  up                    up
Virtual-Access2    unassigned      YES unset  up                    up

HYD-1#
```

HYD-1 # **show ip route**

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route

Gateway of last resort is 202.1.0.17 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 202.1.0.17
      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.0.0.0/8 is directly connected, FastEthernet0/0
L        10.0.0.1/32 is directly connected, FastEthernet0/0
      202.1.0.0/32 is subnetted, 2 subnets
C        202.1.0.17 is directly connected, Dialer1
C        202.1.0.18 is directly connected, Dialer1
HYD-1#
```

Verify communication from LAN to the Internet.

Verification from PC1

ping 8.8.8.8

PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=62 time=24.0 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=62 time=24.1 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=62 time=24.0 ms

LAB 47: PASSWORD RECOVERY

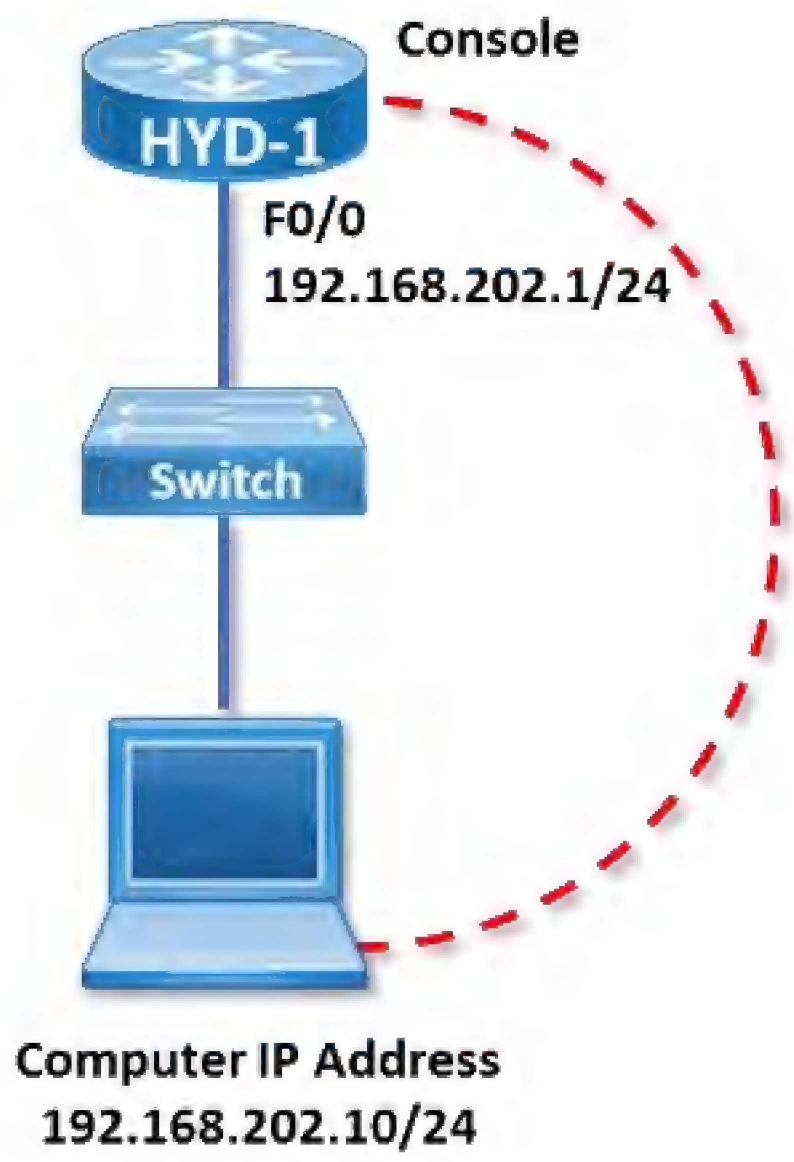
OBJECTIVE:

To get access to a router's privilegd mode in case the enable password is forgotten.

To reset the Privilege / Enable mode password of Cisco Router.

TOPOLOGY:

Setup Console and Ethernet connectivity for the lab as below:



TASK:

- Establish console connectivity
- Access router via console with an emulation software
- Enter Rom Monitor Mode and Change Register Value
- Load saved configuration to the router (i.e. NVRAM to RAM)
- Reconfigure Privilege Mode / Enable Password
- Reset the Configuration Register Value back to the default:
- Enable the Ethernet interface:
- Save configuration to the router and restart the router
- Verify login to the router using new password

Establish console connectivity

Establish console connectivity by connecting router console port to PC Com Port with console cable.

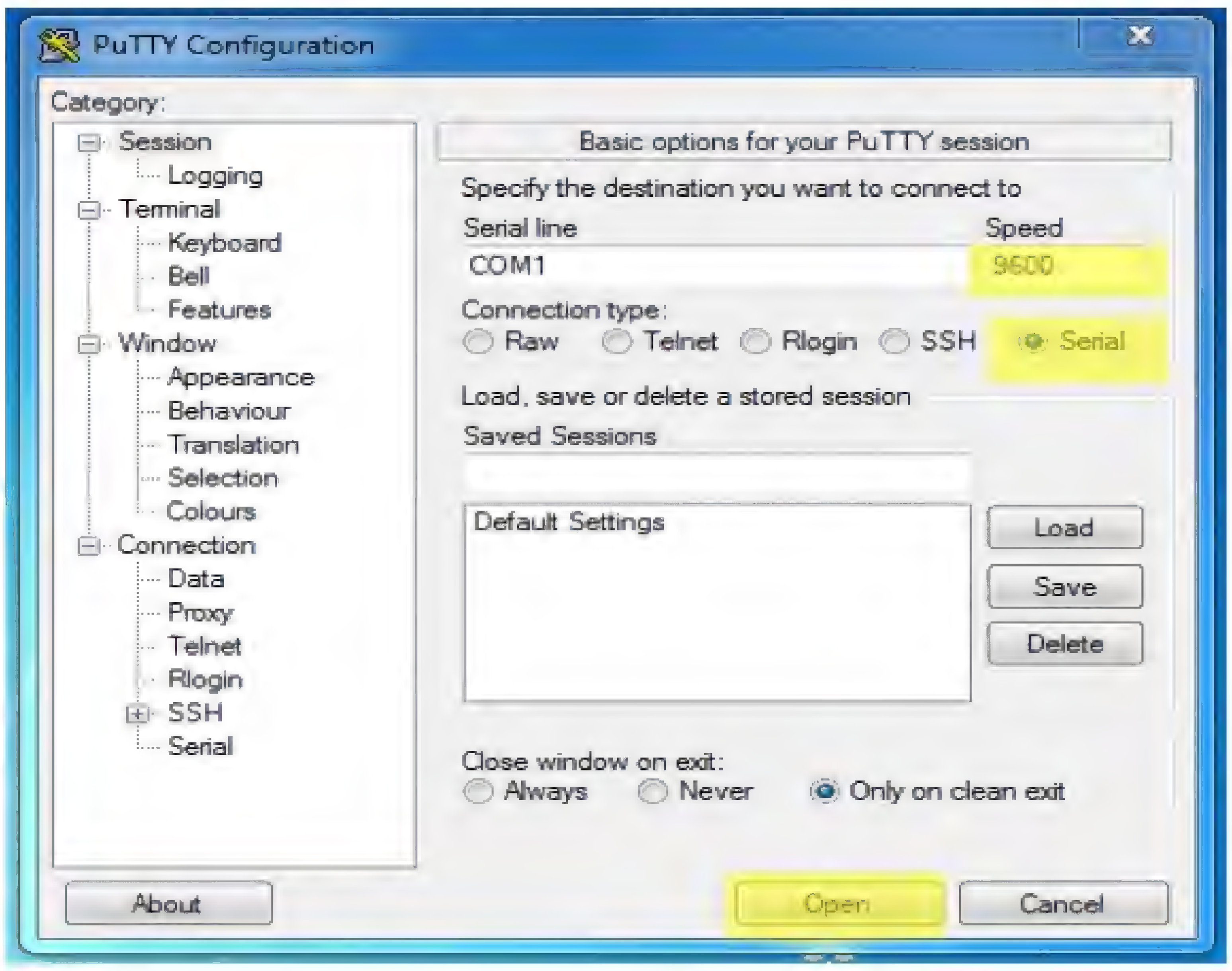
Access router via console with an emulation software

Configure the following parameters in emulation software for accessing switch via console port.

Parameters	Console Port Settings
Baud	9600
Data bits	8
Parity	None
Stop bits	1

Accessing router via console from Microsoft Windows Computer

- Start a terminal emulator application, such as **PUTTY.exe**
- Select **Serial** option and set speed to **9600.**
- Click **Open**



- Once emulation software is ready, **Power-ON** the switch.

Accessing router via console from Linux Computer

- From the terminal enter the below command
  \# **minicom**

Enter Rom Monitor Mode and Change Configuration Register Value

Once emulation software is ready, Press **"Ctrl + Break"** within 60 sec after **POWER-ON**. Router will Enter **Rom monitor mode**.

rommon 1>

Configure Register Value 0x2142 to skip executing the startup configuration from nvram during bootup.

rommon 1 > **confreg 0x2142**
rommon 2 > **reset**

After the Router boots-up completely, it enters setup mode as below:

System Configuration Dialog
Would you like to enter the initial configuration dialog? [Yes/no]: **no**
Would you like to terminate autoinstall? [yes]: **yes**

If you choose "Yes", IOS will prompt questions to gather the information to configure the Router, it is recommended to choose "no", since we can configure the Router using IOS commands

Router >**enable**

Load saved configuration to the router

Router # **copy startup-config running-config**
Destination filename [running-config]?
HYD-1 #

Reconfigure Privilege Mode / Enable Password

Since we are already in the privilege mode, we can setup a new privilege password.

HYD-1 # **configure terminal**
HYD-1 (config) # **enable secret cisco**
HYD-1 (config) # **exit**

Reset the Configuration Register Value back to the default:

HYD-1 (config)# **config-register 0x2102**

Enable the Ethernet interface:

HYD-1 (config)# **interface FastEthernet0/0**
HYD-1 (config-if)# **no shutdown**
HYD-1 (config-if)# **^Z**

Similarly apply the "no shutdown" command on all required interface

Saving configuration to the router and restart the router

To save configuration on router

HYD-1 # **copy running-config startup-config**

Destination filename [startup-config]?
Building configuration...

[OK]
HYD-1 #

HYD-1 # **reload**

Verify login to the router using new password

- Access router via telnet and Enter privilege mode using new password.

  telnet 192.168.202.1

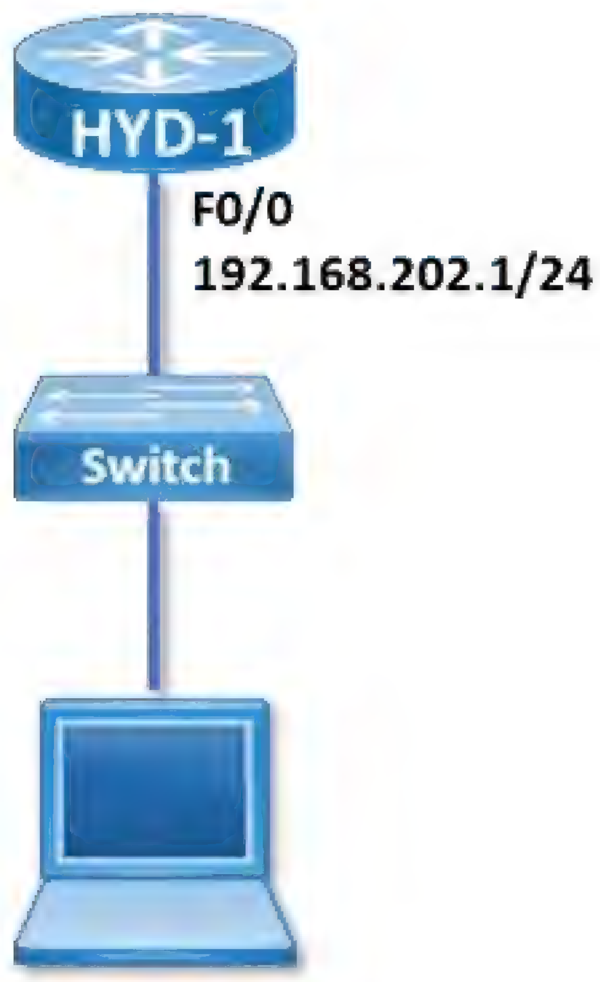
LAB 48: IOS AND CONFIGURATION BACKUP

OBJECTIVE:

To take backup of the IOS and the Router Configuration

TOPOLOGY:

Setup Ethernet connectivity for the lab as below:



Pre-requisite: 192.168.202.10 computer should have TFTP , FTP and SCP server software installed and running.

TASK:

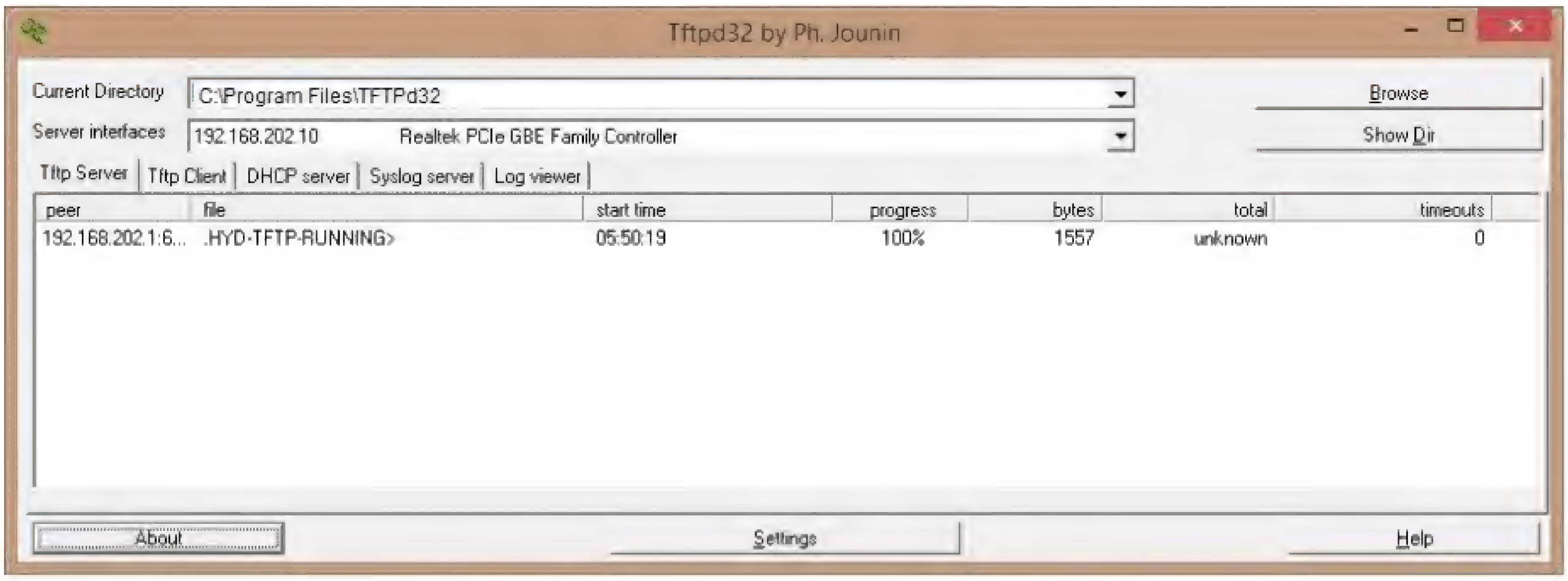
- Create a backup of Router Configuration on TFTP Server
- Verify Configuration file on TFTP server
- Create a Backup of Router IOS on TFTP Server
- Verify IOS file on TFTP server
- Create a backup of Router Configuration on FTP Server
- Verify Configuration file on FTP server
- Create a Backup of Router IOS on FTP Server
- Verify IOS file on FTP server

Backup of Router Configuration on TFTP Server

HYD-1 # **copy startup-config tftp**
Address or name of remote host []? **192.168.202.10**
Destination filename [HYD-confg]? **HYD-TFTP**
!!
1514 bytes copied in 0.344 secs (4401 bytes/sec)
HYD-1 #

Verify backup configuration file on TFTP Server

Verify the Configuration file on TFTP server, default path is **C:\Program Files\TFTPd32**



Backup of Router IOS

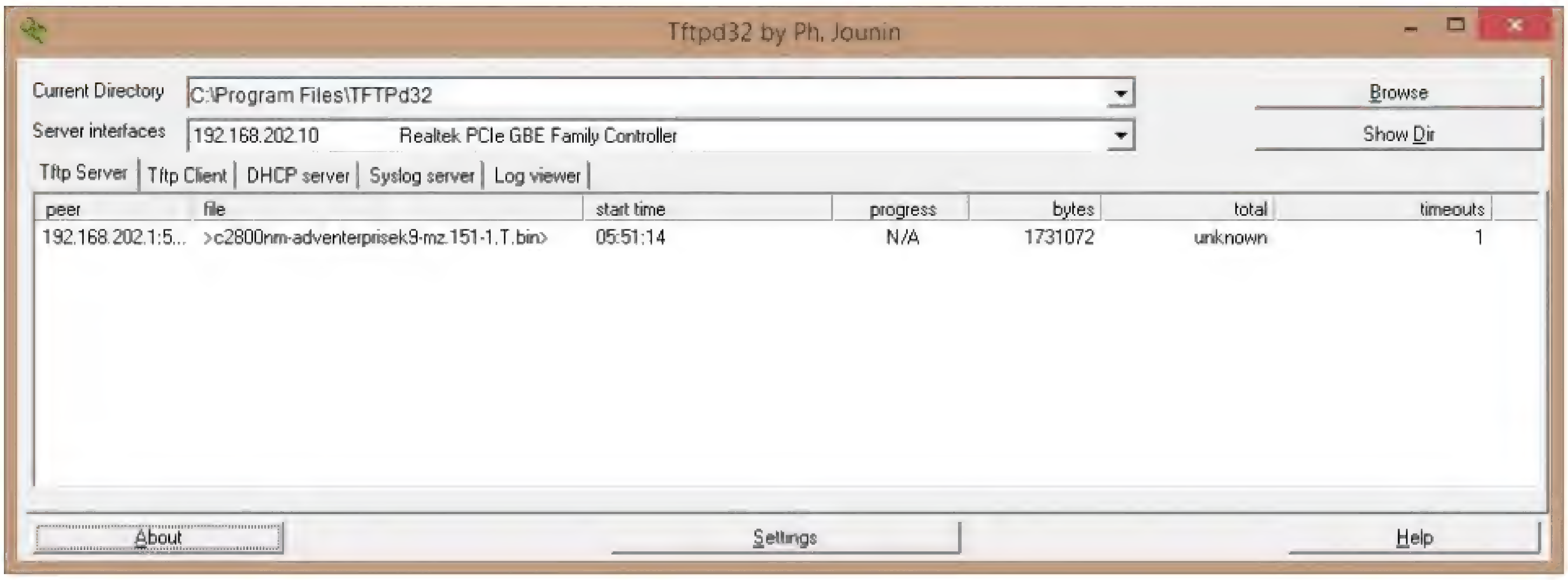
HYD-1 # **show flash**
System flash directory:
File Length Name/status
1 63139972 Aug 01 2016 14:13:20 c2800nm-adventerprisek9-mz.151-1.T.bin
856064 bytes available (63156224 bytes used)

HYD-1 #

HYD-1 # **copy flash tftp**
Source filename []? **C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN**
Address or name of remote host []? **192.168.202.10**
Destination filename [C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN]?
!!!
!!!
!!!
!!
63139972 bytes copied in 264.584 secs (238639 bytes/sec)
HYD-1 #

Verify backup IOS file on TFTP server

Verify the IOS file on TFTP server, default path is **C:\Program Files\TFTPd32**



Backup of Router Configuration on FTP Server

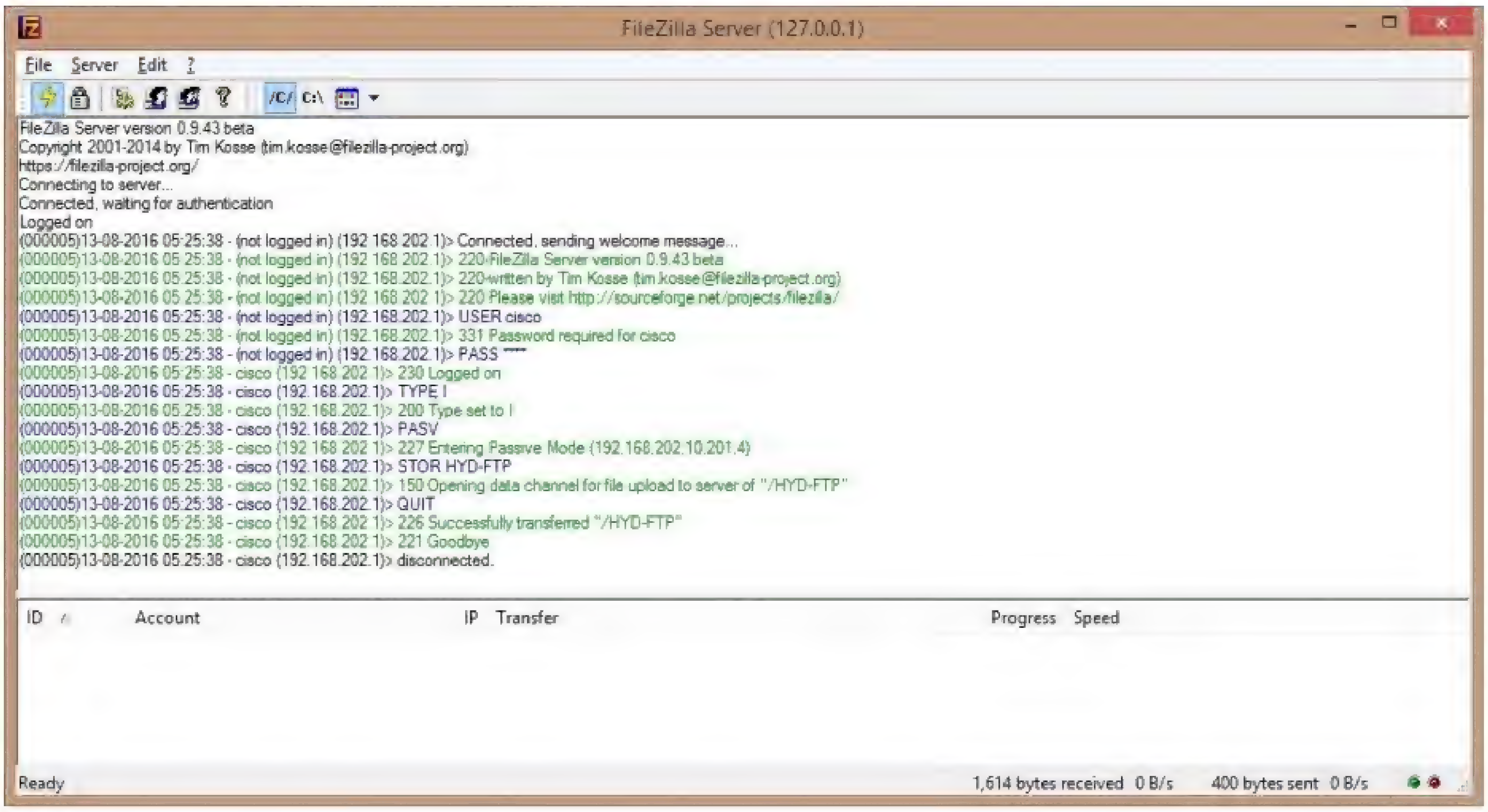
HYD-1 # **configure terminal**
Enter configuration commands, one per line. End with CNTL/Z.
HYD-1 (config) # **ip ftp username cisco**
HYD-1 (config) # **ip ftp password ccna**
HYD-1 (config) # **end**

HYD-1 # **copy startup-config ftp:**
Address or name of remote host []? **192.168.202.10**
Destination filename [HYD-confg]? **HYD-FTP**

Writing HYD-FTP !!
1557 bytes copied in 0.476 secs (3271 bytes/sec)
HYD-1 #

Verify backup configuration file on FTP Server

Verify the Configuration file on FTP server.



Backup of Router IOS

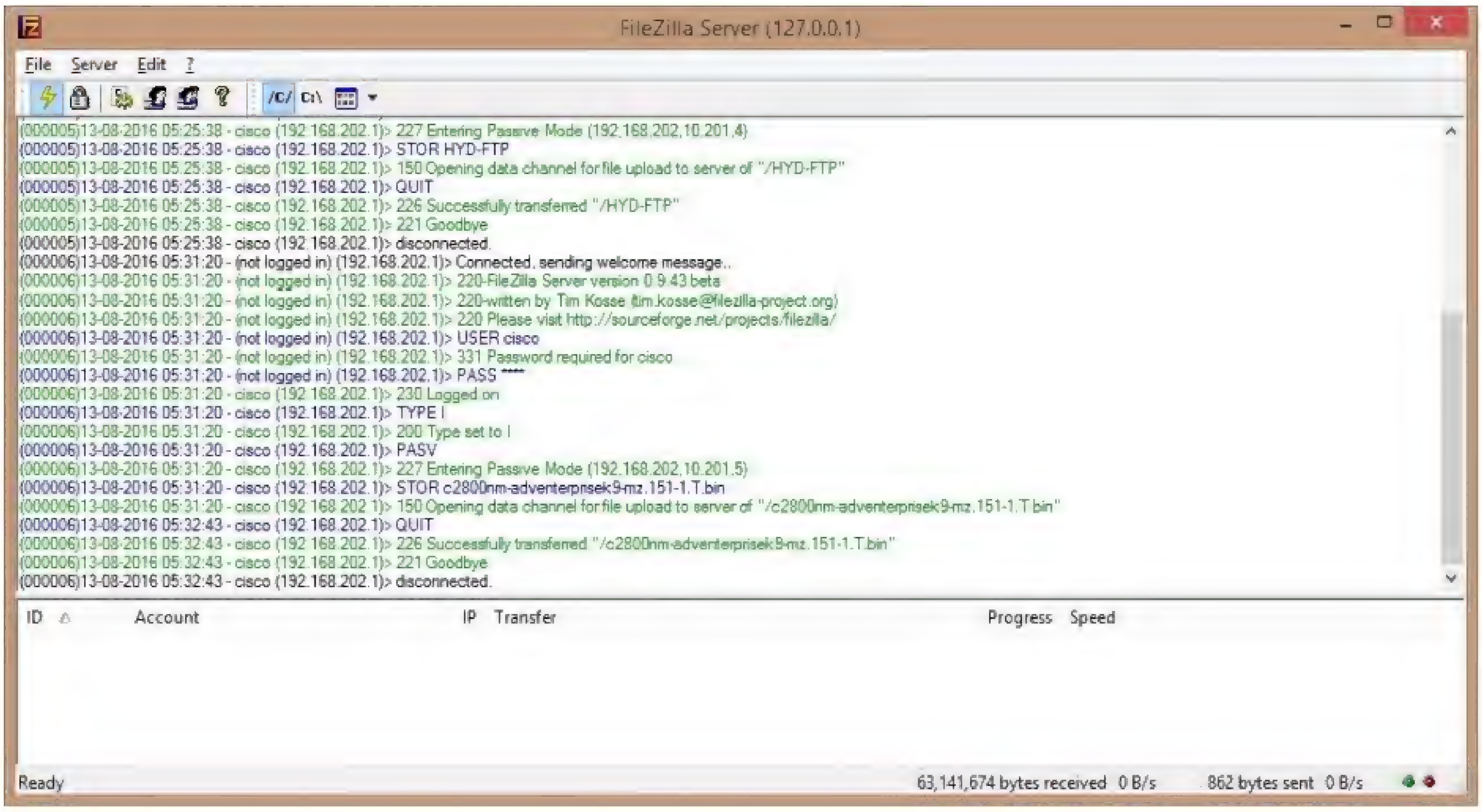
HYD-1 # **show flash**
System flash directory:
File Length Name/status
1 63139972 Aug 01 2016 14:13:20 c2800nm-adventerprisek9-mz.151-1.T.bin
856064 bytes available (63156224 bytes used)

HYD-1 #

HYD-1 # **copy flash ftp:**
Source filename []? **C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN**
Address or name of remote host []? **192.168.202.10**
Destination filename [C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN]?
Writing C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN !!
!!
!!
!!
!!!
63139972 bytes copied in 264.584 secs (238639 bytes/sec)
HYD-1 #

Verify backup IOS file on FTP server

Verify the IOS file on FTP server.



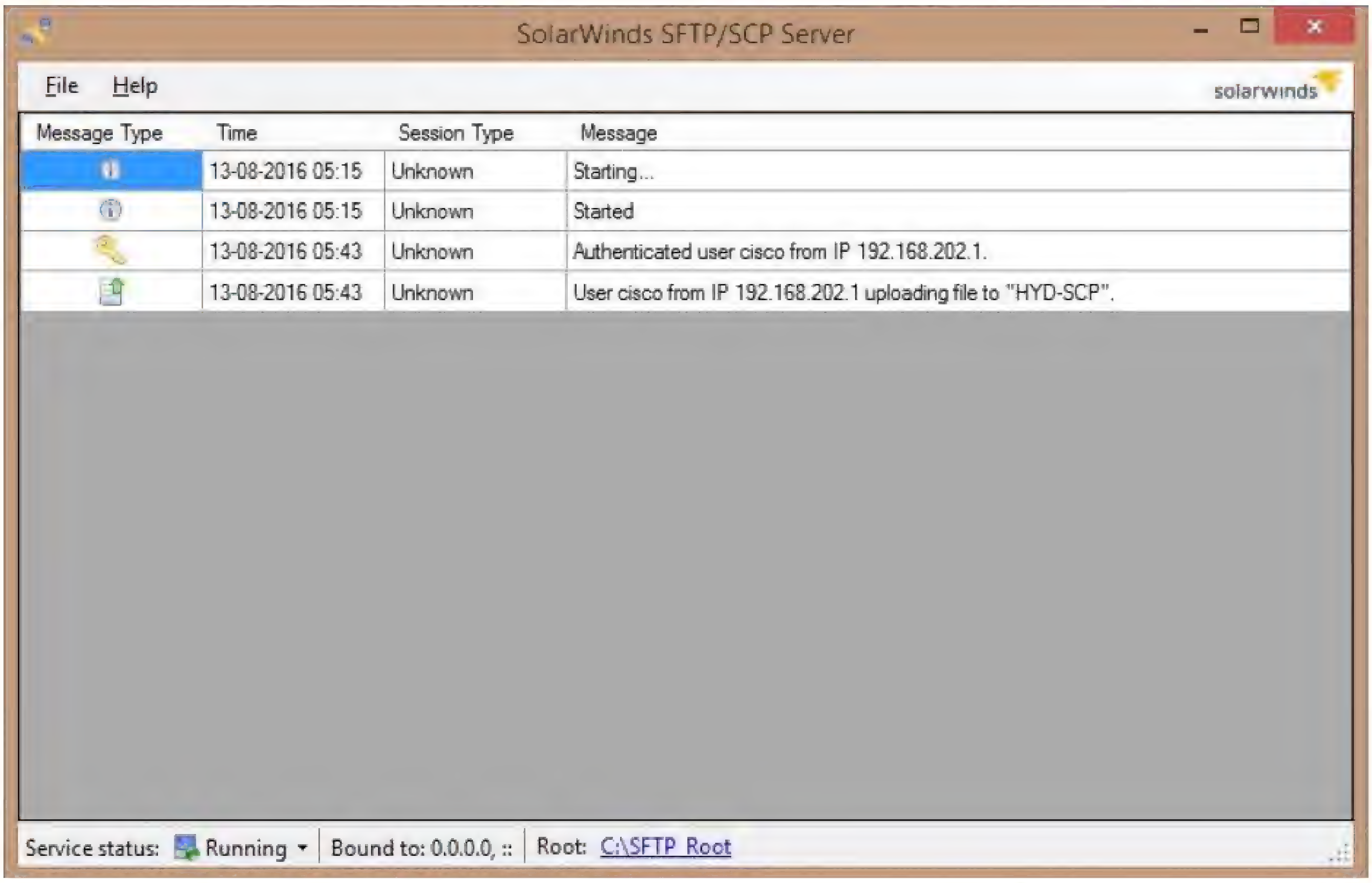
Backup of Router Configuration on SCP Server

HYD-1 # **copy startup-config scp:**
Address or name of remote host []? **192.168.202.10**
Destination username [HYD-1]? **cisco**
Destination filename [HYD-confg]? **HYD-SCP**

Writing HYD-SCP
Password: **ccna**
!!
1557 bytes copied in 0.476 secs (3271 bytes/sec)
HYD-1 #

Verify backup configuration file on SCP Server

Verify the Configuration file on SCP server, default path is **C:\SFTP_Root.**



Backup of Router IOS

HYD-1 # **show flash**
System flash directory:
File Length Name/status
1 63139972 Aug 01 2016 14:13:20 c2800nm-adventerprisek9-mz.151-1.T.bin
856064 bytes available (63156224 bytes used)

HYD-1 #

HYD-1 # **copy flash scp:**
Source filename []? **C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN**
Address or name of remote host []? **192.168.202.10**
Destination username [HYD-1]? **cisco**
Destination filename [C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN]?

Writing C2800NM-ADVENTERPRISEK9-MZ.151-1.T.BIN
Password: **ccna**
!!
!!
!!
!!
63139972 bytes copied in 264.584 secs (238639 bytes/sec)
HYD-1 #

Verify backup IOS file on FTP server

Verify the IOS on SCP server, default path is **C:\SFTP_Root.**

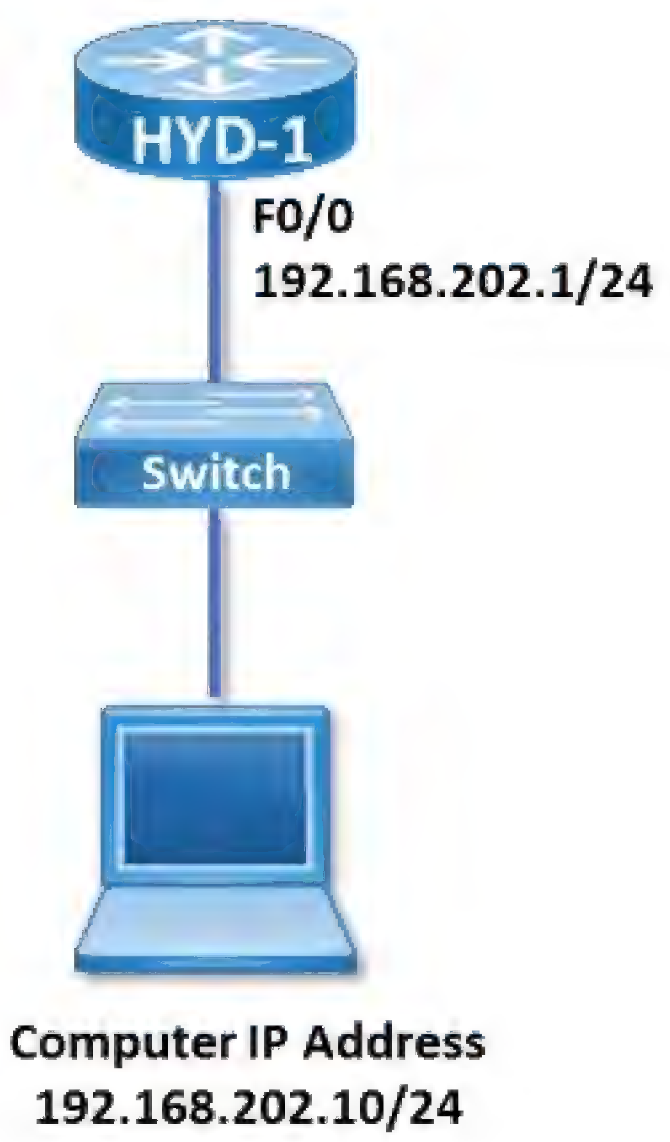
LAB 49: IOS Licensing

OBJECTIVE:

To understand and install Cisco IOS license on router

TOPOLOGY:

Setup Ethernet connectivity for the lab as below:



Pre-requisite: 192.168.202.10 computer should have TFTP server software installed and running.

TASK:

- Verify Cisco IOS License
- Install License on Cisco Router

Verify Cisco IOS LIcense

```
HYD-1 # show license
Index 1 Feature: ipbasek9
Period left: Life time
License Type: Permanent
      License State: Active, In Use
      License Count: Non-Counted
      License Priority: Medium
Index 2 Feature: securityk9
      Period left: Life time
      License Type: Permanent
      License State: Active, In Use
      License Count: Non-Counted
      License Priority: Medium
Index 3 Feature: uck9
      Period left: Not Activated
      Period Used: 0  minute  0  second
      License Type: EvalRightToUse
      License State: Not in Use, EULA not accepted
      License Count: Non-Counted
      License Priority: None
Index 4 Feature: datak9
Period left: 8  weeks 3  days
Period Used: 2  hours 44 minutes
      License Type: Evaluation
 !
<output omitted>
 !
HYD-1 #
```

```
HYD-1 # show license udi

Device#  PID              SN                 UDI
--------------------------------------------------------------------------------------------
*0       CISCO2911/K9     FGL161710K3        CISCO2911/K9:FGL161710K3

HYD-1 #
```

Installing License on Cisco Router

```
HYD-1 # license install tftp:FGL161710K3.lic
Source filename []?FGL161710K3.lic
Address or name of remote host []? 192.168.202.10
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Installing...Feature:datak9...Successful:Supported
1/1 licenses were successfully installed

HYD-1 #
```

Note: Reload the router and verify license is installed using **show license** command.

CHALLENGE LAB

NAT – QUESTION

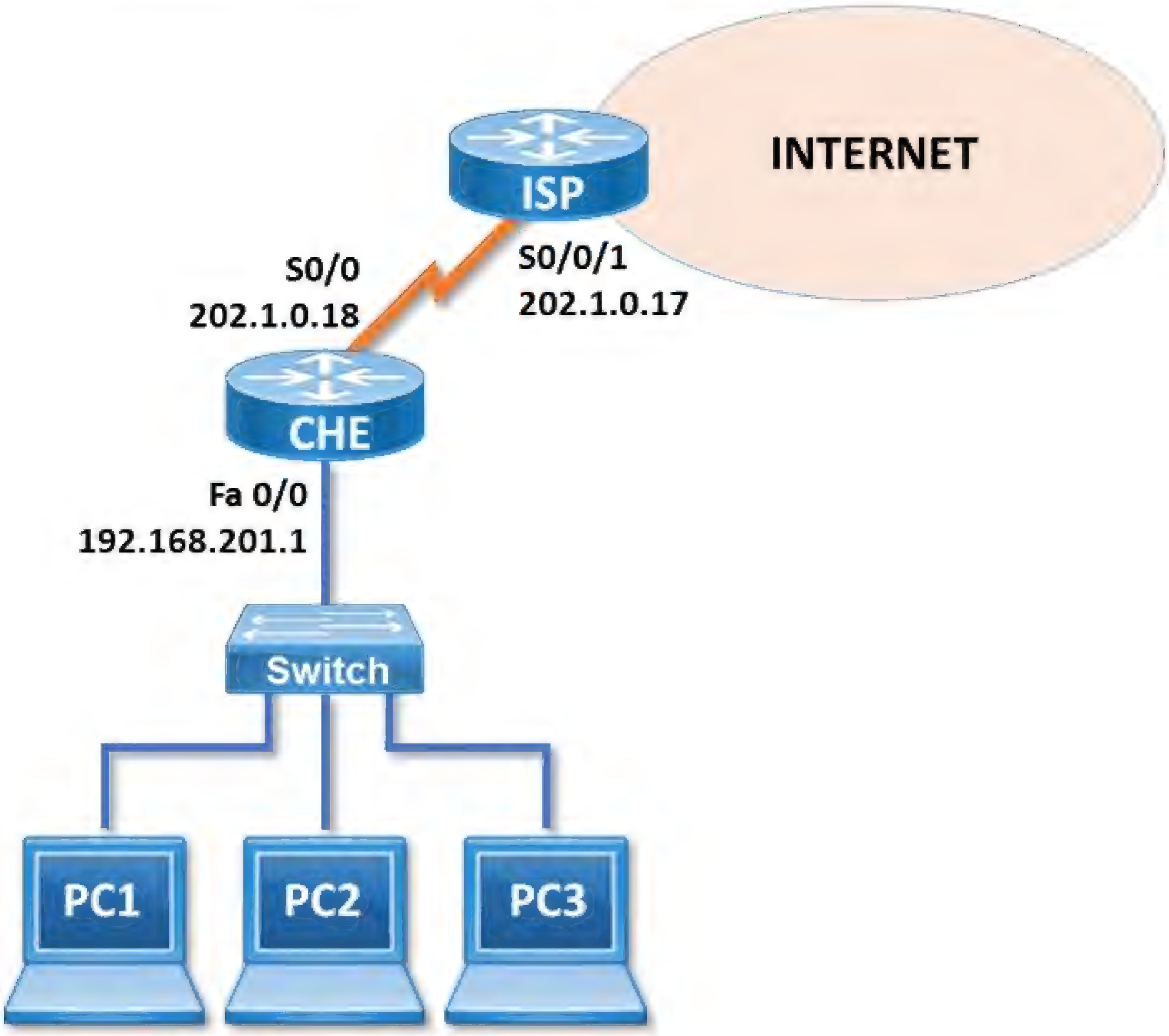
A network associate is configuring a router for the XYZ company to provide internet access. The ISP has provided the company 4 public IP addresses from 202.1.0.19 201.1.0.22. The company has 14 hosts that need to access the internet simultaneously. The hosts in the company LAN have been assigned private space addresses in the range of 192.168.201.17 – 192.168.201.30.

The following has already been configured on the router :

- The basic router configuration
- The appropriate interfaces have been configured for NAT inside and NAT outside
- The appropriate static routes have also been configured
- All passwords have been temporarily set to "cisco"

Topology:

Connectivity and IP address for the lab are as below:



Interface	Network ID / Mask
Fa 0/0	192.168.201.0/24
S 0/0	202.1.0.16/29

NAT – SOLUTION

Verify Existing CHE Configuration

```
CHE # show running-config
Using 791 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname CHE
!
enable password cisco
!
interface FastEthernet0/0
 ip address 192.168.201.1 255.255.255.0
ip nat inside
 duplex auto
 speed auto
!
!
interface Serial0/0/0
 ip address 202.1.0.18 255.255.255.248
ip nat outside
!
ip route 0.0.0.0 0.0.0.0 Serial0/0/0
!
line con 0
!
line aux 0
!
line vty 0 4
 password zoom
 login
!
!
!
end
```

The XYZ company has 14 hosts that need to access the internet simultaneously but we just have 4 public IP addresses from 202.1.0.19 to 202.1.0.22/29. So we need to configure NAT overload (or PAT).

Create a NAT pool of global addresses to be allocated with their netmask. i.e. /29 = 255.255.255.248

CHE (config) # **ip nat pool mypool 202.1.0.19 202.1.0.22 netmask 255.255.255.248**

Create a standard access control list that permits the addresses that are to be translated

CHE (config) # **access-list 1 permit 192.168.201.16 0.0.0.15**

Establish dynamic source translation, specifying the access list that was defined in the prior step

CHE (config) # **ip nat inside source list 1 pool mypool overload**

This command translates all source addresses that match the**access list 1** i.e. source address from **192.168.201.17 to 192.168.201.30**, into an address from the pool named **mypool** i.e. the pool of ip addresses from **202.1.0.19 to 202.1.0.122**. **Overload** keyword allows mapping multiple IP addresses to a single registered IP address (many-to-one) by using different ports

Verify NAT inside and NAT outside statements are configured on correct interfaces.

CHE (config)# **interface F0/0**
CHE (config-if)# **ip nat inside**
CHE (config-if)# **exit**
CHE (config)# **interface S0/0**
CHE (config-if)# **ip nat outside**
CHE (config-if)# **exit**

Save the configuration using below command

CHE# **copy running-config startup-config**

Verify configuration from a Computer:

ping 202.1.0.17

The ping should work and you should get reply packets.

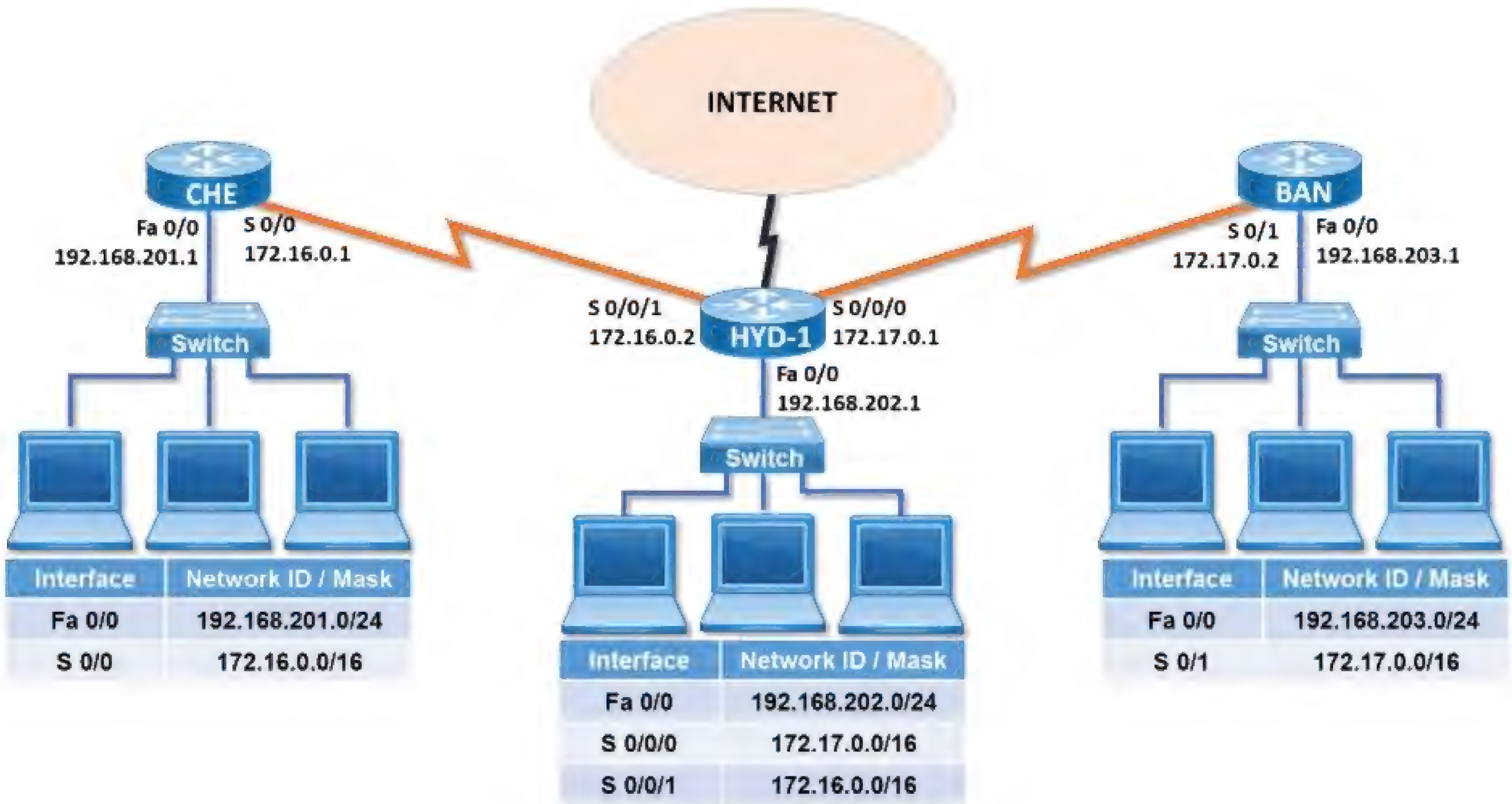
EIGRP – QUESTION

After adding BAN router, no routing updates are being exchanged between HYD-1 and the new location. All other inter connectivity and Internet access for the existing locations of the company are working properly.

The task is to identify the fault(s) and correct the router configuration to provide full connectivity between the routers. All passwords on all routers are "cisco"

Topology:

Connectivity and IP address for the lab are as below :



EIGRP – SOLUTION

Verify Existing CHE Configuration

CHE # **show running-config**

```
CHE#sh running-config
Building configuration...

Current configuration : 837 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname CHE
!
<output omitted>
!
interface FastEthernet0/0
 ip address 192.168.201.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial0
 ip address 172.16.0.1 255.255.0.0
 clock rate 64000
!
router eigrp 10
 network 172.16.0.0
 network 192.168.201.0
 no auto-summary
!
<output omitted>
!
!
end
```

Verify Existing HYD-1 Configuration

HYD-1 # **sh running-config**

```
Building configuration...

Current configuration : 868 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname HYD-1
```

```
!
<output omitted>
!
!
interface FastEthernet0/0
ip address 192.168.202.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial0/0/0
 ip address 172.16.0.2 255.255.0.0
!
interface Serial0/0/1
 ip address 172.17.0.1 255.255.0.0
 clock rate 64000
!
router eigrp 10
 passive-interface Serial0/0/1
 network 192.168.202.0
 network 172.16.0.0
 no auto-summary
!
<output omitted>
!
end
```

Verify Existing BAN Configuration

BAN # **sh running-config**

```
Building configuration...

Current configuration: 819 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
!
hostname BAN
!
<output omitted>
!
interface FastEthernet0/0
ip address 192.168.203.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial0/0/0
 ip address 172.17.0.2 255.255.0.0
!
!
```

```
router eigrp 11
 network 192.168.203.0
 network 172.17.0.0
 no auto-summary
!
ip classless
!
<output omitted>
!
end
```

From the above outputs, we now know that router **BAN** is wrongly configured with an **AS No. 11** and all other routers are configured with **AS No. 10**. Whenever the AS numbers among routers are mismatched, no adjacency is formed.

To resolve this issue, simply re-configure EIGRP commands on router BAN :

BAN >**enable**
BAN # **configure terminal**
BAN (config)# **no router eigrp 11**
BAN (config)#**router eigrp 10**
BAN (config-router)# **network 192.168.203.0**
BAN (config-router)# **network 172.17.0.0**
BAN (config-router)# **no auto-summary**
BAN (config-router)# **end**

Save the configuration using the command below

BAN# **copy running-config startup-config**

From the HYD-1 output, we had found out 2 issues

- All networks on HYD-1 are not advertised in EIGRP configuration.
- passive-interface command given for the interface connected to BAN router

Advertise Missing Networks in EIGRP Configuration

HYD-1 >**enable**
HYD-1 # **configure terminal**
HYD-1 (config)# **router eigrp 10**
HYD-1 (config-router)# **network 172.17.0.0**
HYD-1 (config-router) # **end**

Disable Passive Interface command for interface connected to BAN router

HYD-1 (config) # **router eigrp 10**
HYD-1 (config-router) # **no passive-interface serial 0/0/1**
HYD-1 (config-router) # **end**

Save the configuration using below command

HYD-1 # **copy running-config startup-config**

Check the routing table on BAN. You should now be able to see all the routes.

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